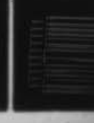
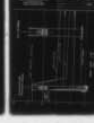
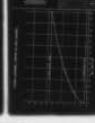
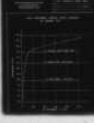
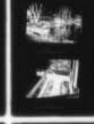
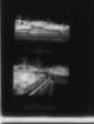
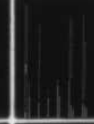
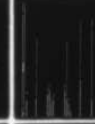
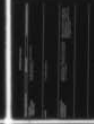
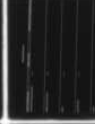
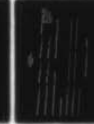
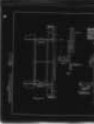
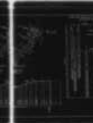
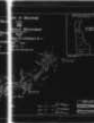
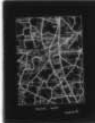


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NANTICOKE RIVER BASIN  
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DELAWARE

# WILLIAMS POND DAM DE 00064

## PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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Philadelphia District  
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DE00064	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Williams Pond Dam Sussex County, Delaware		5. TYPE OF REPORT & PERIOD COVERED (9) FINAL rept.
7. AUTHOR(s) (10) I. Wayne Lippincott, P.E.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Moore and Lippincott-Engineers 67 Scotch Rd. Trenton, N.J. 08628		8. CONTRACT OR GRANT NUMBER(s) (15) DACW61-78-C-0124
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (12) 448 P.		12. REPORT DATE (11) April, 1979
		13. NUMBER OF PAGES 80
		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (6) National Dam Safety Program, Williams Pond Dam (DE00064), Nanticoke River Basin, Clear Brook, Sussex County, Delaware. Phase I Inspection Report.		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams                                      National Dam Inspection Act Report Spillway                                  Williams Pond Dam, Del. Overtopping Visual Inspection		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's ade- quacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. 440 894		

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Honorable Pierre S. DuPont  
Governor of Delaware  
Dover, Delaware 19901

11 JUN 1975

Inclosed is the Phase I Inspection Report for Williams Pond Dam in Sussex County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Williams Pond Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. However, the dam's spillway is considered inadequate since 11 percent of the 100 year Flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

- (1) Regrade and provide slope protection for the eroded embankment areas.
- (2) An annual inspection visit should be initiated using a visual check list similar to the one enclosed in this report. All drawings and computations relating to repair, renovation and maintenance of the dam should be kept as a matter of record. All visits to the dam for operation and maintenance should be logged as a matter of record.

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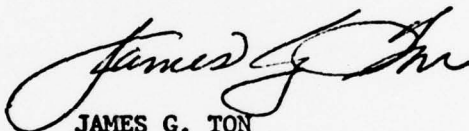
Honorable Pierre S. DuPont

A copy of the report is being furnished to Mr. Austin P. Olney, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

1 Incl  
As stated

Cy furn:  
Mr. Austin P. Olney, Secretary  
Department of Natural Resources and  
Environmental Control



WILLIAMS POND DAM (DE00064)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 7 December 1978 by Thomas Tyler Moore and Lippincott Engineering Associates, joint venture under contract to the U. S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

Williams Pond Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. However, the dam's spillway is considered inadequate since 11 percent of the 100 year Flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

(1) Regrade and provide slope protection for the eroded embankment areas.

(2) An annual inspection visit should be initiated using a visual check list similar to the one enclosed in this report. All drawings and computations relating to repair, renovation and maintenance of the dam should be kept as a matter of record. All visits to the dam for operation and maintenance should be logged as a matter of record.

APPROVED: 

JAMES G. TON

Colonel, Corps of Engineers  
District Engineer

DATE: 11 June 1979



PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Williams Pond Dam ID # DE 00064  
State Located: Delaware  
County Located: Sussex  
Stream: Clear Brook & Herring Run  
Date of Inspection: 7 December 1978

Brief Assessment of General Condition:

Based on visual inspection, available records, calculations and past operational performance, Williams Pond Dam is considered to be in good overall condition. The existing spillway has a hydraulic capacity equal to 10% of the peak SDF outflow before the low point of the embankment is overtopped, and is therefore considered hydraulically inadequate.

No serious deficiencies that affect public safety were noted during inspection. Some erosion of the earthfill embankment has been noted in this report, which can easily be rectified by implementing minor grading and riprap, in the future.

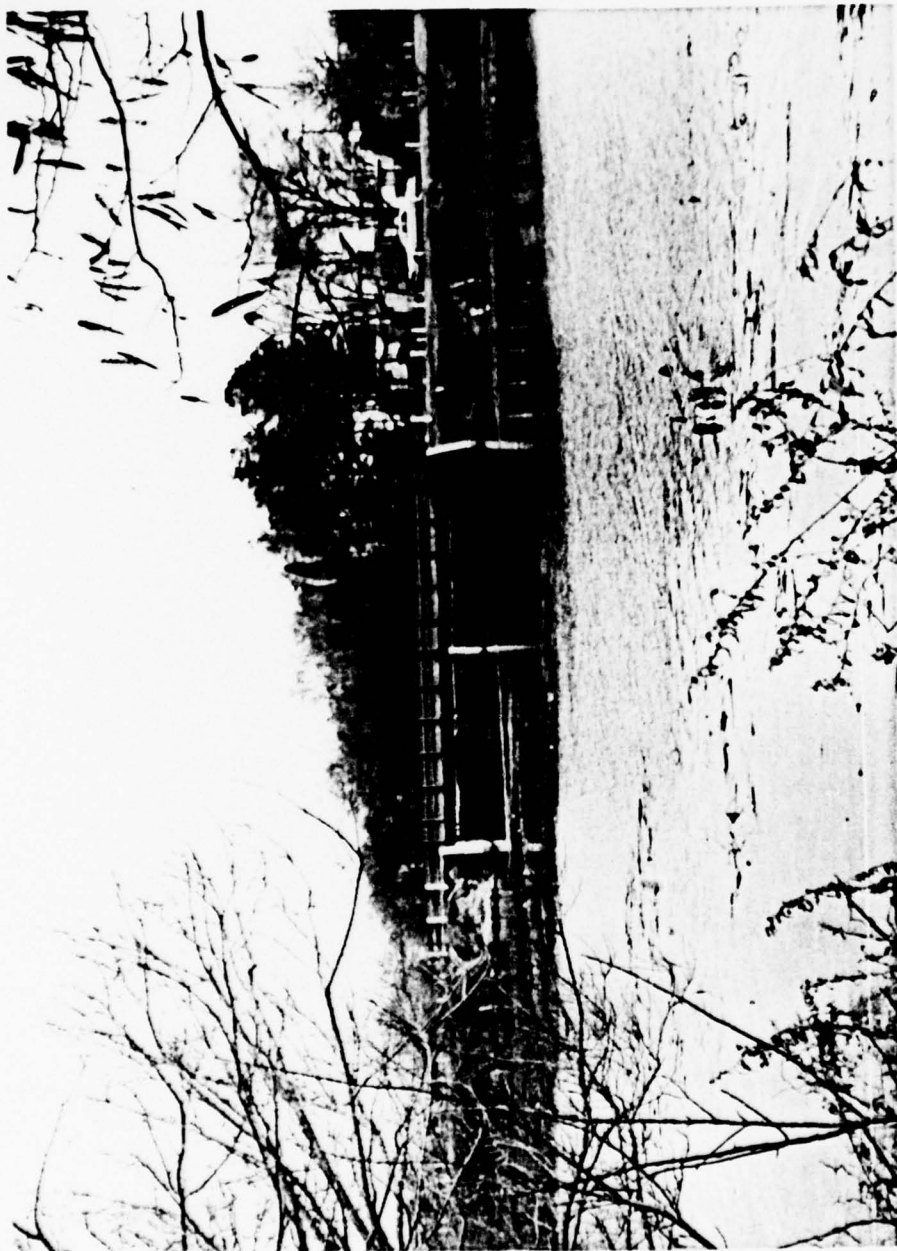
Based upon our visual inspection downstream of Williams Pond Dam, the hazard potential classification has been downgraded from "High Hazard Potential" to "Low Hazard Potential". In our judgement failure of the dam would not result in the loss of life or substantial property damage downstream.

MOORE & LIPPINCOTT - ENGINEERS

I. Wayne Lippincott, P.E., P.P.  
Project Manager

IWL:bc





OVERALL VIEW  
OF  
DAM

DEC. 7, 1978



## WILLIAMS POND DAM

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## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigation, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
WILLIAMS POND DAM

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Dam Inspection Act, Public Law 92-367, dated August 8, 1972, provides for the report herein. The inspection of Williams Pond Dam was initiated under Contract DACW61-79-C-006 with the Department of the Army, Philadelphia District, Corps of Engineers by the engineering firms of Thomas Tyler Moore Associates and Lippincott Engineering Associates under a joint venture.

b. Purpose of Inspection

The purpose of the inspection is to evaluate the general condition of Williams Pond Dam and bring to the attention of the owner those conditions which are a threat to public safety. The National Inventory of Dams will be updated by the data accumulated during this inspection.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Williams Pond Dam consists of an overflow structure located within an earth-fill embankment dam. The overflow structure consists of gates with wooden stoplogs five feet long, forming twelve spillway overflow drops. Each overflow drop can be individually opened or closed by removing the individual stoplogs.

The roadway embankment on either side of the overflow spillway is approximately five feet higher in elevation at crest than the crest of the overflow spillway.



Williams Pond varies in depth, but soundings taken during our survey indicate a maximum depth of 8 feet immediately upstream of the dam structure and embankment.

Williams Pond extends 4000 feet upstream of the dam axis. The banks of the lake are low sloping and well vegetated.

Route 535, a roadway bridge, is located 400 feet downstream of Williams Pond Dam. The top of the roadway bridge deck is at elevation 11.8 M.S.L., being approximately 4 feet above Williams Pond normal lake elevation. The effective area beneath the Route 535 Bridge is 1429 square feet. Five hundred feet downstream of the Williams Pond Dam and one hundred feet below the Route 535 bridge, the channel discharges into the Nanticoke River in Sussex County. Between Route 535 and the Nanticoke River are approximately six residences, visually judged to be located 5 feet above the downstream channel at that point. The approximate high tide elevation of the downstream channel at this point is 2.5 feet  $\pm$  M.S.L., five feet below normal lake elevation.

b. Location

Williams Pond Dam is downstream of two tributaries, Herring Run to the west and Clear Brook to the north. Clear Brook Tributary connects the Hearn's Pond Reach to Williams Pond. Hearn's Pond is located approximately 7100 $\pm$  feet upstream; its normal lake elevation is approximately 27 M.S.L., and the storage of Hearn's Pond at normal pool elevation is 298  $\pm$  acre-feet. The Williams Pond Dam is approximately 500 feet northeast of its confluence with the Nanticoke River in Sussex County, Delaware.

c. Size Classification

The maximum height of the dam is nineteen (19) feet. The maximum reservoir volume is 800 acre-feet. Therefore, the size category of the dam is small, i.e., the height is less than forty feet and the storage volume is less than 1000 acre-feet.



d. Hazard Classification

Immediately downstream of Williams Pond Dam is located a Delaware State Highway Bridge Structure, Route 535. The bridge roadway is approximately four (4) feet above normal lake elevation and the effective orifice under the bridge is equal to 1429 square feet. One hundred feet downstream of Route 535 is located the Nanticoke River in Sussex County. The downstream channel averages approximately 150 feet in width, its most narrow point being at the bridge structure. Between the bridge and the river are located approximately six homes judged to be five feet above the normal downstream channel.

In our judgement, failure of the dam would not result in the loss of life or substantial property damage downstream. Therefore, Williams Pond Dam is hereby downgraded from a High Hazard Potential Dam to a Low Hazard Potential Dam.

e. Ownership

Delaware Department of Transportation, Dover, Delaware.

f. Purpose of Dam

The purpose of Williams Pond Dam is to impound water for recreational and aesthetic purposes. There are a significant number of residential property owners along the upstream lake shore.

1.3 PERTINENT DATA

a. Drainage Area

23.23 square miles (combined areas of Hearn's & Williams Pond).

b. Discharge At Damsite

Maximum known flood at damsite is unknown.

Warm water outlet at pool elevation:

None

Diversion tunnel low pool outlet at pool elevation:

N/A



Diversion tunnel outlet at pool elevation:	None
Gated spillway capacity normal pool elevation 7.5 M.S.L.:	100 CFS
Gated spillway capacity at maximum pool elevation 12.0 M.S.L.	
Gates at Elevation 7.5 M.S.L.:	618 CFS
Ungated culvert capacities at maximum pool elevation, Gates Pulled:	2916 CFS
Total spillway capacity at maximum pool elevation:	642 CFS

c. Elevation (Feet Above Mean Sea Level [M.S.L.])

Top Dam:	12' MSL $\pm$
Maximum pool-design surcharge:	14.3' MSL $\pm$
Full flood control pool:	N/A
Normal Pool:	7.5' MSL $\pm$
Spillway Crest (gated):	7.5' MSL $\pm$
Upstream portal invert diversion tunnel:	N/A
Downstream portal invert diversion tunnel:	N/A
Streambed at centerline of dam:	1' MSL $\pm$
Maximum tailwater:	2.76' MSL (Mean High Tide)

d. Reservoir (Feet)

Length of maximum pool:	6000
Length of normal pool:	4000
Length of flood control pool:	N/A

e. Storage (Acre-Feet)

Normal pool:	425
Flood control pool:	N/A
Top of dam:	800
Design surcharge:	800

f. Reservoir Surface (Acres)

Normal pool:	35 Ac
Top of dam:	47 Ac



Flood control pool:	N/A
Maximum pool:	49 Ac
Recreational pool:	N/A

g. Dam

Type: Bridge with center pier 60 feet total span by 40 feet wide, set within a 15 foot high earth fill embankment. Twelve (12) overflow spillways regulated by stoplogs (nine [9] 5 foot long, 3" x 12" stoplogs). Total width between abutments is 60 feet.

Length: Concrete bridge deck, 60 feet between abutments. Earth embankment 567 feet.

Height: The maximum height of the embankment is 19 feet at the extreme ends. The minimum height is 13 feet at the bridge deck surface. The average M.S.L. elevation is 12 feet.

Top Width: At the bridge deck - 40 feet.  
At the widest point - 75 to 100 feet.

Embankment Slopes: Upstream - 2:1  
Downstream - 2:1

Lake Slopes: North side - 10:1  
South side - 2:1

Downstream Channel: North side - 2:1  
South side - 8:1

Impervious Core: Unknown

Cutoff: Unknown

Grout Curtain: Unknown

h. Spillway

Type: Wooden stoplog gates @ bridge with center pier, 12 gated inlets, 5 feet long, each composed of nine (9) 5 foot long, 3" x 12" stoplogs.

Length of Weir: 60 feet



Crest  
Elevation: 7.5 feet M.S.L.

Downstream  
Channel: Bridge consisting of two (2) 30 foot wide channels  
between abutments and center pier discharges to a  
150 foot wide pond subject to tidal influence,  
located between Williams Pond Dam and Route 535.  
Route 535 inlet is 135 feet wide and is located  
400 feet downstream.

i. Regulating Outlets

None other than the stoplog gates.



## SECTION 2 - ENGINEERING

### 2.1 DESIGN

Drawings were provided by the Delaware Department of Transportation, entitled Plans For Contract No. 1312. Signatures noted on the drawings indicate approval by the bridge engineer, construction engineer and the chief engineer, in October, 1953.

#### Drawing #1

This drawing, being primarily a Title Sheet, provides some basic summary data and provides information regarding prior site conditions. This drawing does not show the existence of a prior dam.

#### Drawing #2

Drawing #2 is more definitive in showing topography at the embankment breach. It also provides boring locations and logs taken for the reconstruction of the dam. A roadway profile showing existing and proposed centerline grades is provided. The limits and extent of the embankment fill are noted, but no material or construction specifications are called.

#### Drawings #3, #4 & #6

The above drawings contain plan provisions for construction of the foundation, abutment, center pier and beams, dikes and other miscellaneous details for structure.

#### Drawing #5

This drawing shows the limits and extent of the proposed sheet piling cut-off wall. Across the spillway steel sheeting was called while at the wingwalls, timber sheeting was noted. It appears from the information provided on the boring logs that the sheeting was to be driven into the sand and gravel stratum.

No hydraulic computations were uncovered at the time of this investigation. It is not known if a stability analysis was



performed for the reconstructed embankment within the old channel.

A preliminary "as built" survey is provided for orientation and to check against the construction drawings.

## 2.2 CONSTRUCTION

The Delaware Department of Transportation was contacted for as-built plans. According to phone conversations with Dover, records were kept regarding pile cutoff and concrete cylinder breaks. It is doubtful whether more complete information exists. Hydraulic calculations were unobtainable.

## 2.3 OPERATION

No data pertaining to the operation of the structure prior to reconstruction was discovered. Presently the dam is operated by the Delaware Department of Transportation. Stoplogs are pulled by the maintenance personnel in anticipation of and during rainstorms with any significant accumulation of precipitation.

## 2.4 EVALUATION

### a. Availability

Engineering data is not considered fully adequate to assess the safety of the structure for Phase I Inspection. Data missing pertains to the engineering properties and soil parameters of the embankment, method of construction, zoning and phreatic surfaces. Since no embankment settlements were observed within the old channel, it is presumed that consolidating soils were removed prior to embankment construction.



## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

Williams Pond Dam was found to be in good overall condition at the time of the inspection. The problems noted during the visual inspection are considered minor and do not require immediate remedial attention. Noteworthy deficiencies are described briefly in the following paragraphs. The complete visual inspection check list is given in Appendix A.

#### b. Dam

##### Earthfill

No visible signs of movement either vertically or horizontally were evident. Erosion to the embankment has occurred adjacent to the downstream wingwalls, apparently occurring from poor control of road surface run-off. The total depth of the eroded channels approaches 3 feet. Further, slight erosion is occurring on the upstream side of the embankment at its junction with the dam structure. No seepage was observed in the embankment.

##### Overflow Dam

The concrete abutments and center pier bridge superstructure are in good overall condition. The wooden stoplogs have been slightly damaged by debris impact or water damage and are leaking at the edges where the boards meet. A guard rail post on the top of the embankment has been partially undermined by erosion and there is some slight hairline cracking of bituminous pavement. This would indicate some settlement. Both downstream wingwalls are tilting back into the bank and the bottoms appear to be deflected out. At the northernmost wingwall the wall has been displaced at the top as much as seven inches. However, at present the wingwall appears to be in stable condition. The rotation of the wingwall may be attributed to settlements.



c. Appurtenant Structures

N/A

d. Reservoir Area

The reservoir area of Williams Pond Dam as viewed from the roadway embankment atop the dam appears to have been residentially developed and is under private ownership. The banks are nearly level to gently sloping. Wooded lots and lawns comprise much of the upstream bank. There is no evidence of erosion or steep embankment conditions.

e. Downstream Channel

At the outlet of the Williams Pond Dam the downstream channel is more than 150 feet wide with sharply sloping banks on the north side, approximately 2:1, and gently sloping banks on the south side, approximately 8:1. The wide channel narrows slightly to the entrance beneath Route 535, 400 feet downstream.

f. Evaluations

1. Spillway - The stability of the tilting wingwalls will be discussed in Section 7.
2. Embankment - The effect of road surface runoff on the embankment will be discussed in Section 7.



## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Williams Pond Dam is owned and operated by the Delaware Department of Transportation, Bridge Management Division. The lake level is controlled by removing the stoplogs which comprise the spillway. When the upstream residents experience flooding conditions, the Gravel Hill Section of the Delaware Department of Transportation Maintenance Division is contacted. Maintenance is responsible for the opening of the lake outlets.

### 4.2 MAINTENANCE OF DAM

In conversations with James Moore, Delaware Department of Transportation, Bridge Department, it was determined that the State Department of Transportation inspects the roadway, bridge and earth embankments once every two years. Damage or failure is then reported to the Gravel Hill Maintenance Division of the Delaware Department of Transportation, who effectuates the maintenance.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

In a conversation with Willard Griffith, Superintendent of the Gravel Hill Maintenance Department, it was determined that maintenance occurs on an as-needed basis, as well as in response to the bi-yearly inspection and evaluation of the dam structure.

### 4.4 DESCRIPTION OF A WARNING SYSTEM

Conversation with the Gravel Hill Superintendent indicates that the only warning system in effect for Williams Pond Dam is activated by the upstream residents who call Gravel Hill in the event of their rear yards flooding. According to Mr. Griffith, no flooding has overtopped either the Williams Pond Dam or the nearest downstream channel restriction being the Route 535 overpass.



#### 4.5 EVALUATION

The need for annual inspections and a formal warning system will be discussed in Section 7.



## SECTION 5 - HYDRAULIC/HYDROLOGY

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

Hydraulic and hydrologic features of Williams Pond Dam were predicated upon the Corps of Engineer Guidelines and assistance provided by the Philadelphia District, Corps of Engineers.

Readily available data of the area was not obtainable. Hydraulic capacity of the Williams Pond Dam was assessed using the following data:

Plans obtained from the Delaware Department of Transportation Contract #1312 dated October, 1953.

Field survey of preliminary "as-built" conditions by Thomas Tyler Moore and Lippincott Engineering Associates.

Standard engineering procedures and methods used to compute spillway capacity both in the gated and in the open (gates removed) conditions.

Hydrologic evaluations were based on the following data:

Watershed areas obtained from the U.S.G.S. 7.5 minute quadrangles.

Snyder coefficients and infiltration loss rate coefficients.

The HEC-1 DB program was used to calculate inflows and routing.

Based on the size and hazard potential classification for this dam, the recommended spillway design flood is 50 years to 100 years. For evaluating the adequacy of the spillway,



100 year flood was used as the SDF.

b. Experience Data

No measurements of outflows from the dam or flows within the watershed of the dam are available. However, conversations with State Department of Transportation officials indicate that there is no record of any flood condition overtopping the roadway embankment.

c. Overtopping Potential

Williams Pond Dam has been classified as a "low" hazard, "small" dam. The S.D.F. is therefore a 100 year storm. The total discharge of the S.D.F. through Williams Pond Dam is 5435 C.F.S. This would overtop the embankment crest by 2.34 feet. The total duration of overtopping is 26 hours.

Tidal variations fluctuate from  $-1.8^+$  feet M.S.L. to  $+2.76^+$  feet M.S.L. This would generate a slight tailwater condition having little or no effect on the discharge rate of the S.D.F.

The evaluation presented above reflects present day conditions. It does not consider future development or its effect on the hydrology.

d. Emergency Drawdown

Williams Pond can be emptied by the removal of the wooden stoplog gates. The maximum drawdown potential of the open culvert with a maximum head at an approximate elevation 12 feet M.S.L. would be 2916 C.F.S. Flows of this magnitude could be significant during peak inflows. With no-to-slight inflow it would take approximately 10 hours to drain the reservoir. The current practice is to open the gates during rainstorms to prevent yard flooding upstream and overtopping of the roadway.



## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

Except for the tilting downstream wingwalls, the surface erosion and slightly damaged stoplogs, no significant structural inadequacies were noted during the visual inspection phase of our analysis. No seepage below or around the spillway or embankment was noted. It does not appear that the tilting wingwalls nor the erosion pose a serious structural threat at this time.

#### b. Design and Construction Data

Calculations for embankment slope and foundation stability were not available for our review. General experience with similar slopes, heights, inclinations, materials and hydraulic conditions similar to those of Williams Pond Dam embankment slopes indicates that this dam can be shown to satisfy the stability requirements of "The Recommended Guidelines For Safety Inspection of Dams". This inference is based on stable slope inclinations given by the U.S. Bureau of Reclamation (1960) Design of Small Dams, first edition, pp 195 to 201. In view of the moderate heights and inclinations of the dam slopes, their history of satisfactory performance, and the fact that no indications of instability were observed during the field inspection of December 7, 1978, no further stability assessments are necessary for this Phase I Inspection Report.

#### c. Operating Records

Operating records have not been kept for Williams Pond Dam. No mechanical methods are associated with this dam and the overflow spillway. The lake level is controlled by the stoplog gates at the bridge inlets. Maintenance records are kept by the Delaware State Department of Transportation.



d. Post Construction Changes

Normal maintenance procedures are accomplished on a bi-annual inspection and repair basis, scheduled by the Delaware Department of Transportation, the only changes, visually observed, are erosion control techniques used to stabilize the earth embankment.

e. Seismic Stability

Williams Pond Dam is located in Zone 1 on the Seismic Zone Map of the United States. Experience has shown that structures having adequate stability under static loading conditions will also have adequate stability under Zone 1 level seismic activity. Since this dam demonstrates stability for static loads, no further consideration of seismic stability is necessary.



## SECTION 7 - ASSESSMENT/RECOMMENDATIONS & PROPOSED REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

#### a. Safety

The dam has been inspected visually, in accordance with procedures by the Corps of Engineers for a Phase I Report. Since no engineering data was available for review, our assessment is subject to those limitations inherent in a visual inspection.

The "hazard classification" has been down-graded from "High Hazard Potential" to "Low Hazard Potential". In our judgement loss of life or substantial property damage would not result in the event of dam failure.

Annual inspections are recommended in order to enable the owner to notice variations in appearance of specific portions of the dam.

The spillway has a hydraulic capacity equal to 10% of the peak S.D.F. outflow. The low point of the dam will be overtopped by 2.34 feet during the S.D.F.

Some tilting of the embankment wingwalls was noted. Although movement has occurred, the wall does not appear to be unstable at this time. No cracking is apparent that would indicate an impending structural failure.

No seepage or slope failures were noted during inspection that would indicate potential piping or embankment failure.

No cracking or movement of the concrete spillway structure or timber stoplogs was noted that would indicate a potential structural failure.



Erosion along the earthfill embankment can be prevented by implementing proper grading, seeding and/or riprap.

b. Adequacy of Information

No additional information is required to complete an assessment of the safety of the dam.

c. Urgency

The erosion occurring at the earthfill embankments should be repaired in the future.

d. Necessity for Additional Data

As demonstrated in Section 7.1 a & b, additional data and evaluation is not required.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternative

No alternatives are necessary.

b. O & M Maintenance Procedures

An annual inspection visit should be initiated using a visual check list similar to the one enclosed in this report.

All drawings and computations relating to repair, renovation and maintenance of the dam should be kept as a matter of record.

All visits to the dam for operation and maintenance should be logged as a matter of record.

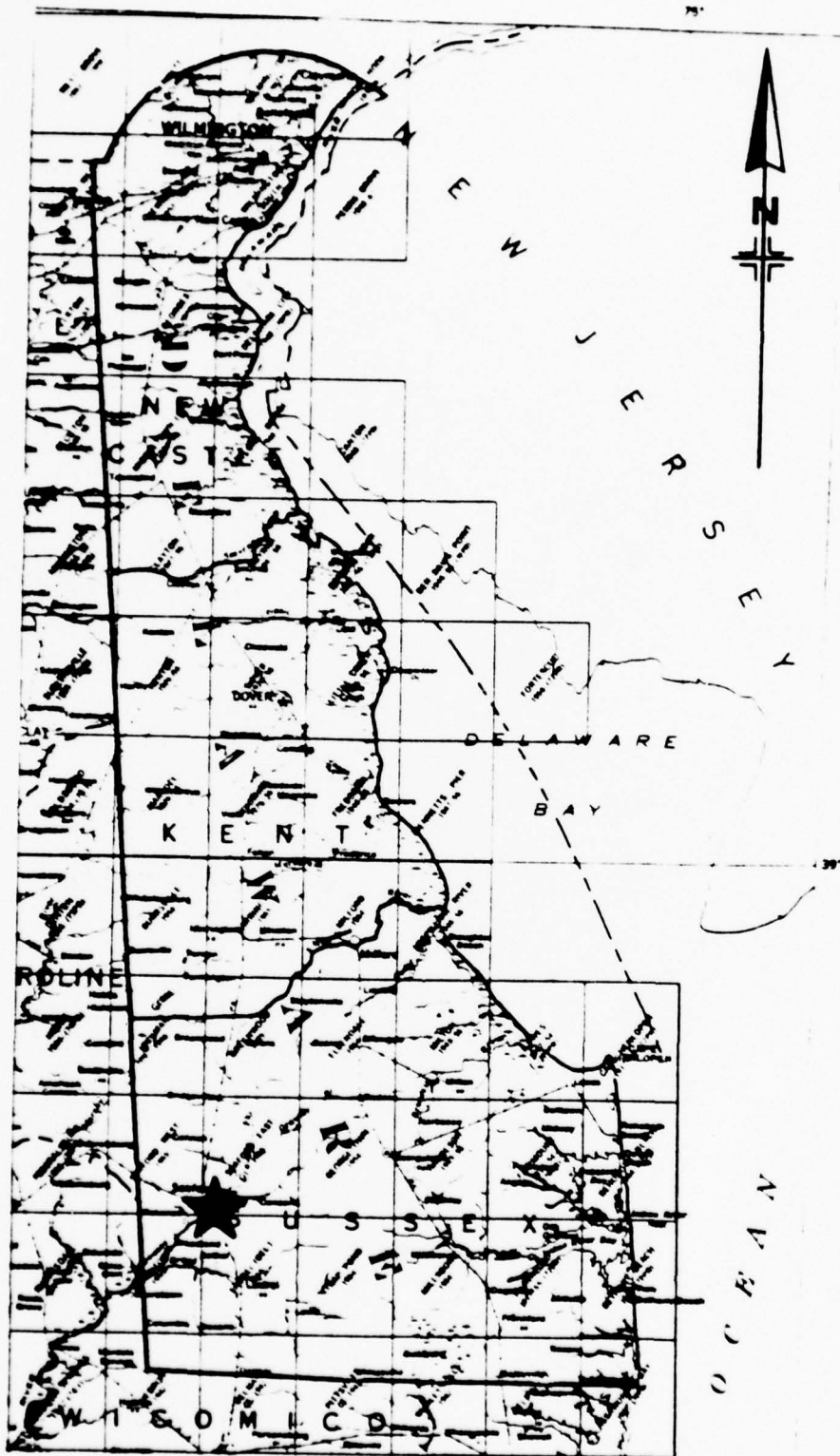


PLATES







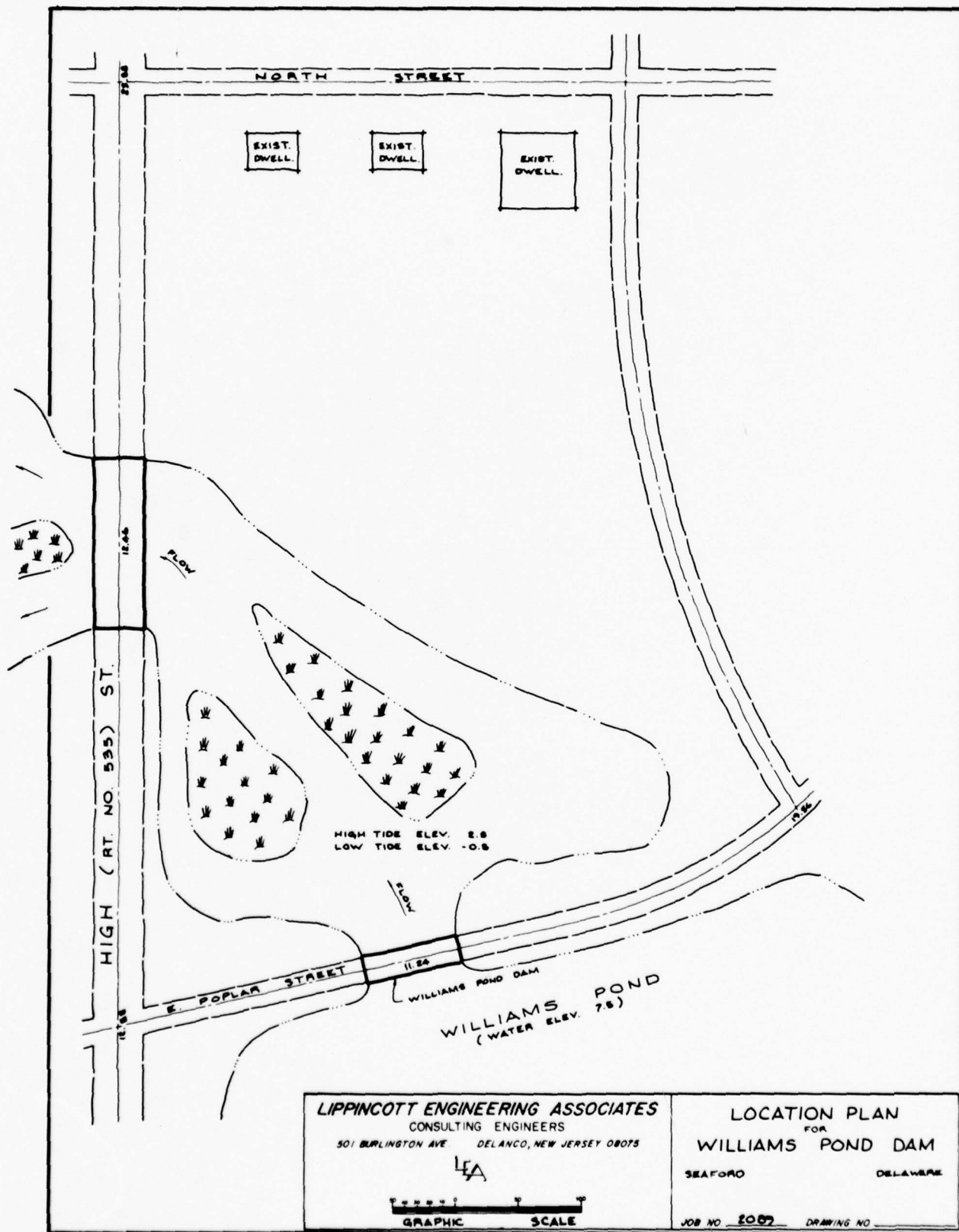


LOCATION MAP

WILLIAMS POND DAM

PLATE #2







Lippincott Engineering Associates

501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

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OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_

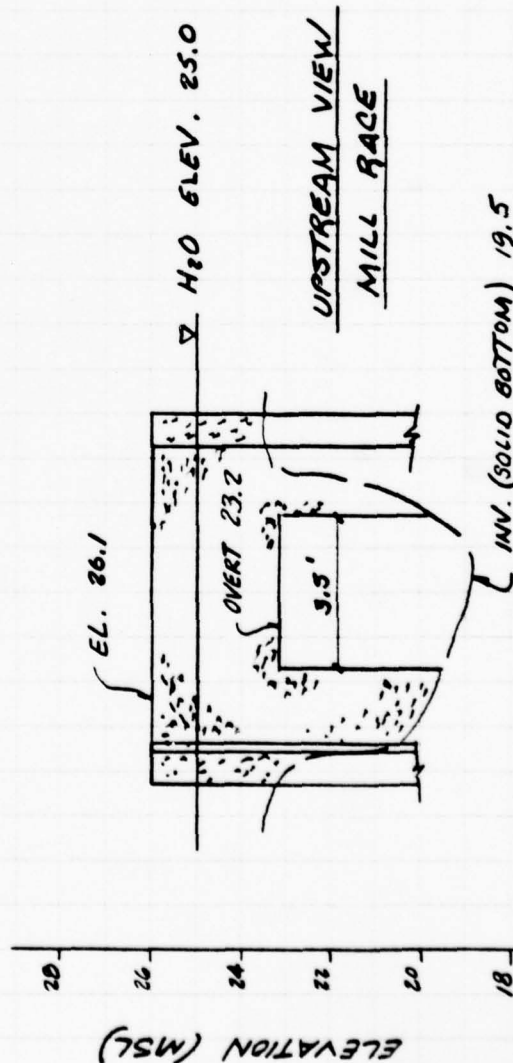
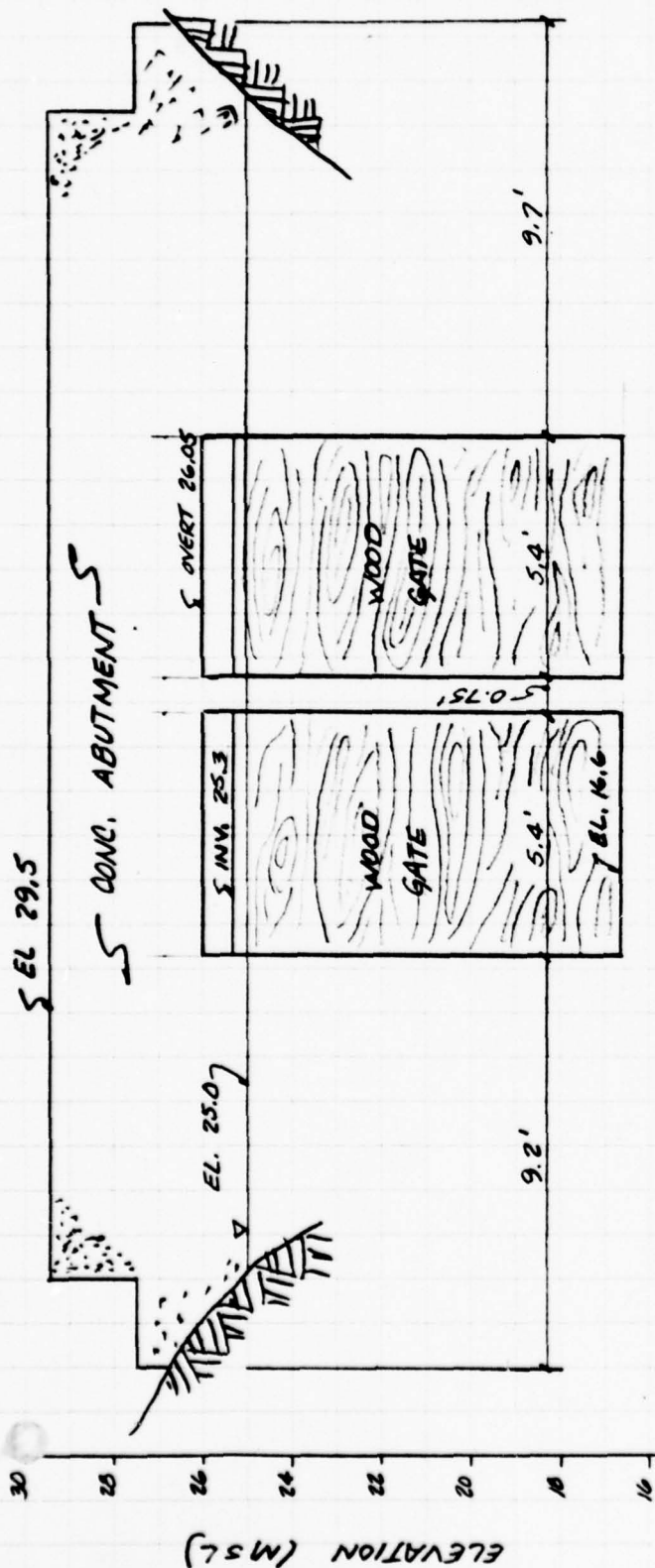
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SCALE: HORIZ. 1"=4'  
VERT. 1"=4'









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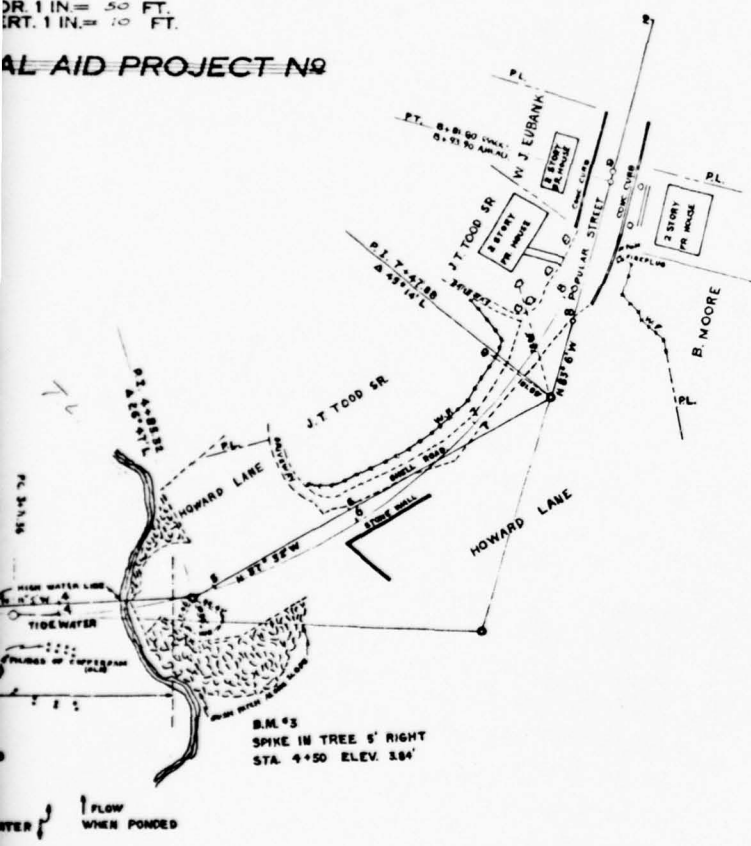


## HWAY DEPARTMENT

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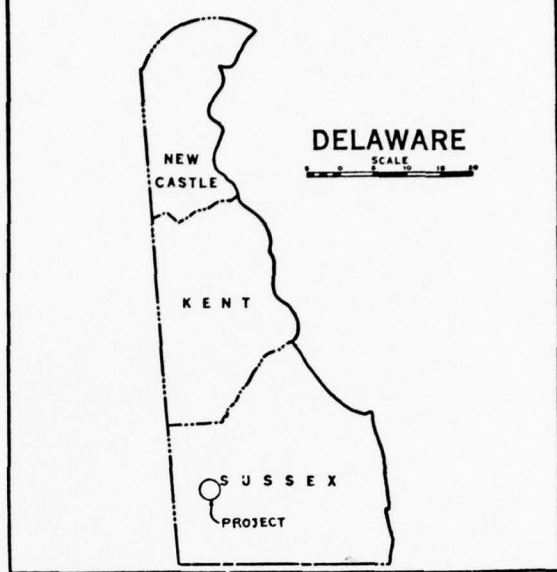
1.50 FT.  
OR 1 IN. = 50 FT.  
RT. 1 IN. = 10 FT.

AL AID PROJECT N<sup>o</sup>



COUNTY	CONTRACT	C. & A. DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
SUSSEX	1312	2	DEL.			1	5

WILLIAMS POND DAM



BOOK NUMBER 3045

B.M. #4  
SPIKE IN POLE 165' RIGHT  
STA. 8+54 ELEV. 3002'

EXAMINED 10/27 1953

APPROVED 10-28 1953

APPROVED 10-28 1953

*Joe S. Robinson*  
DIVISION ENGINEER

*John B. Benson*  
CONSTRUCTION ENGINEER

*Wm. Williams*  
CHIEF ENGINEER

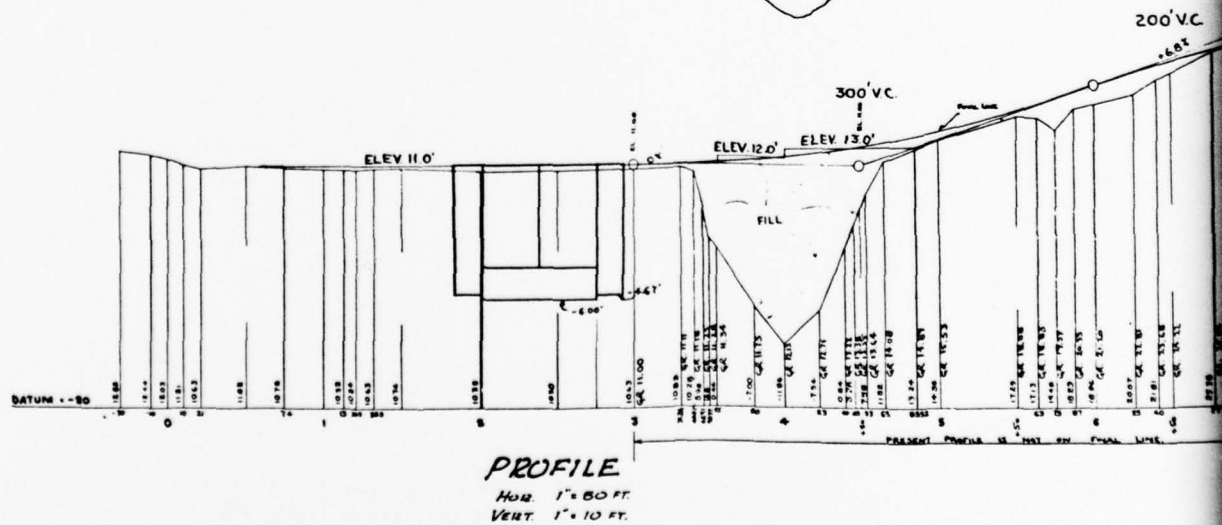
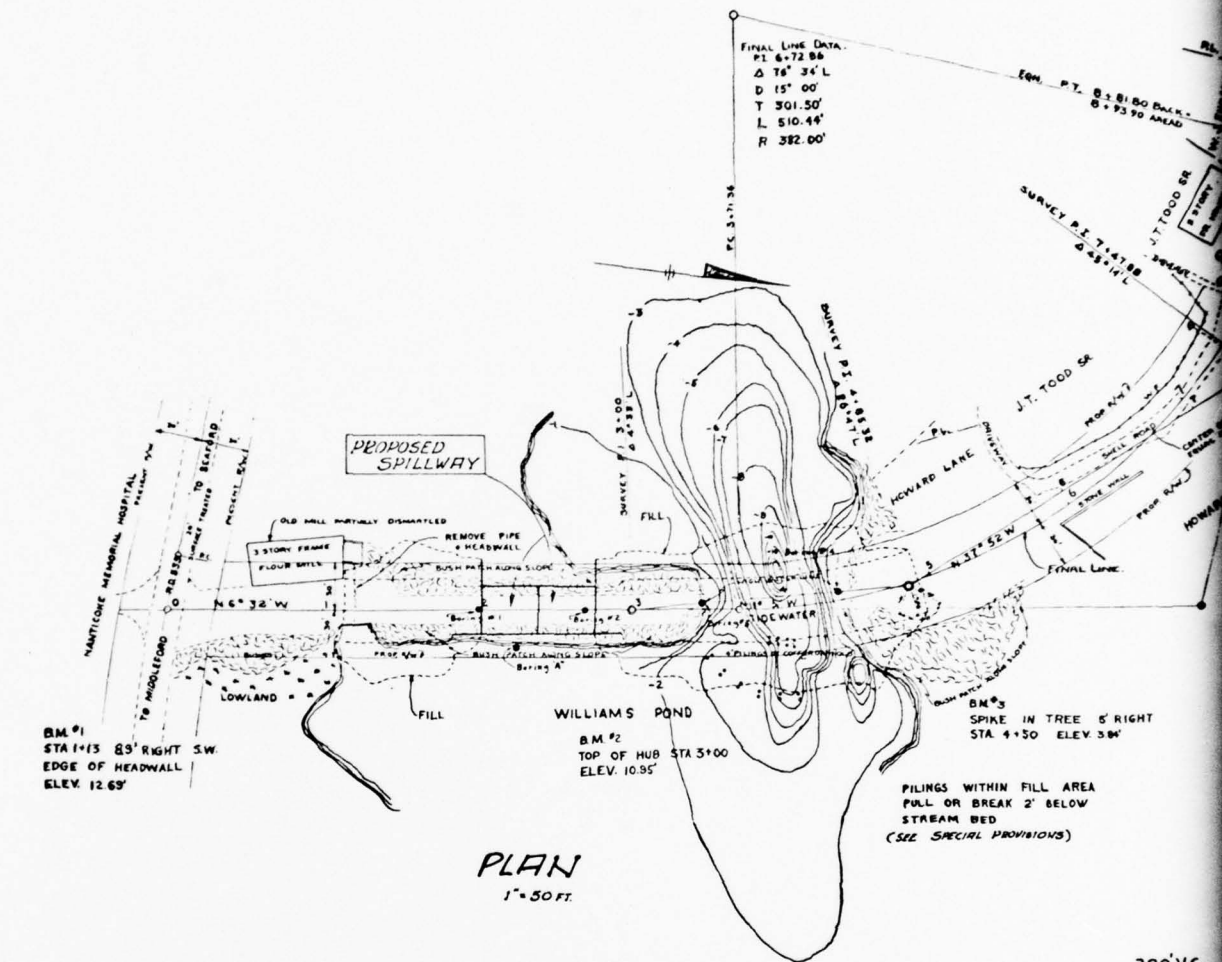
DEPARTMENT OF COMMERCE BUREAU OF PUBLIC ROADS	
RECOMMENDED FOR APPROVAL:	
DISTRICT ENGINEER	DATE
APPROVED:	
DIVISION ENGINEER	DATE

2



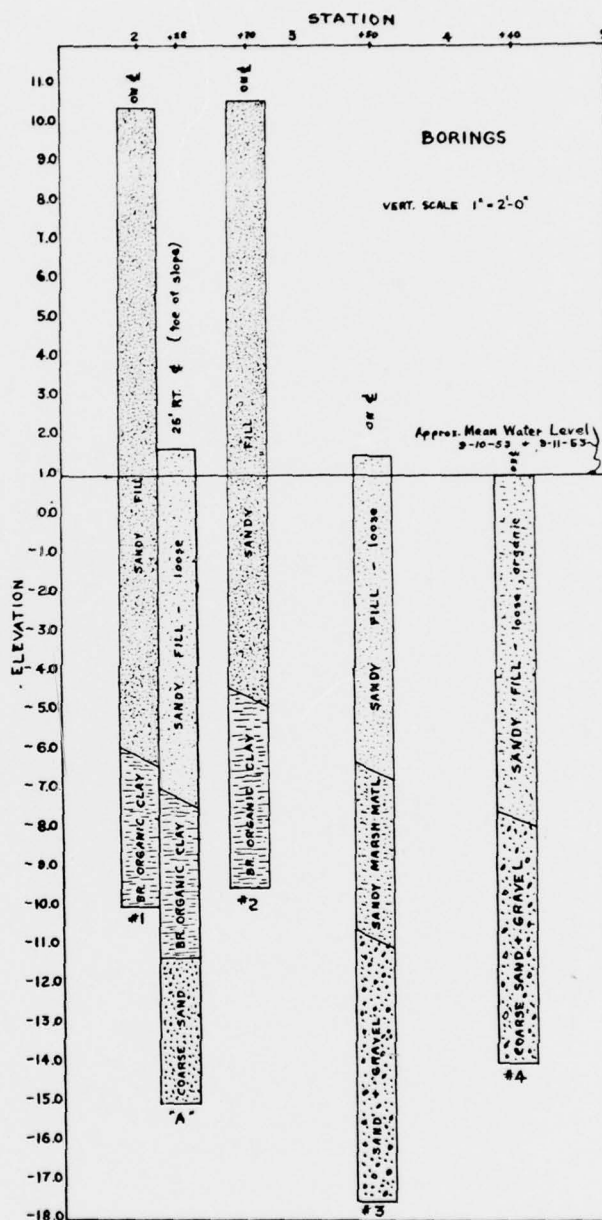
REVISIONS

GRADE & R/W 1-7-52



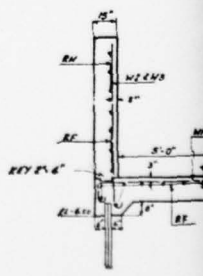
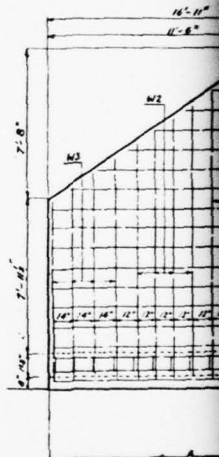
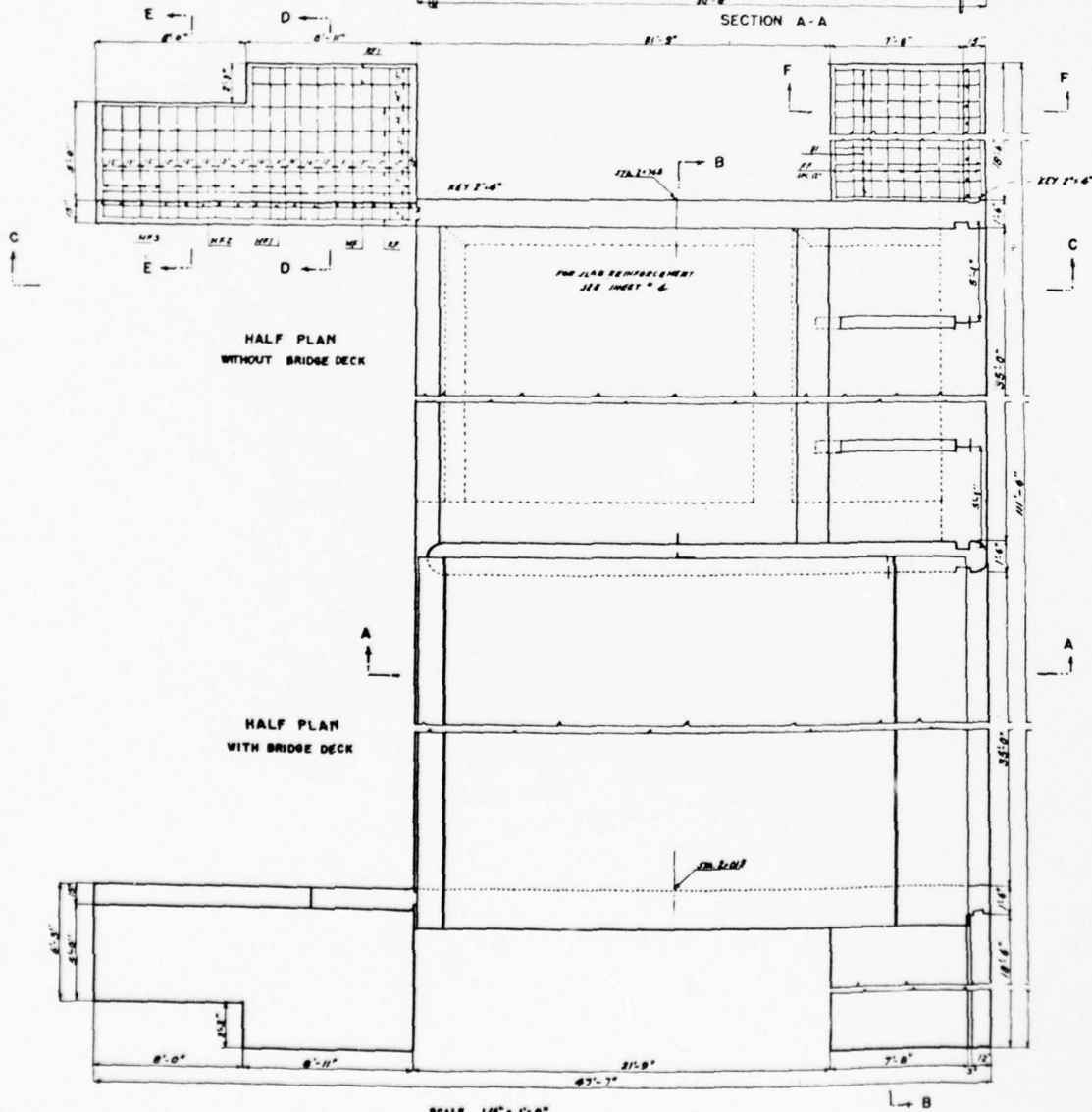
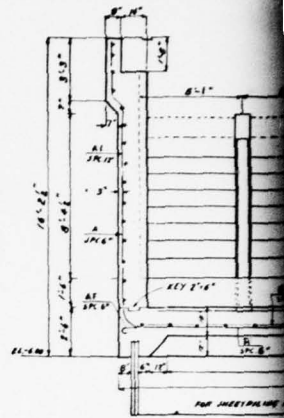
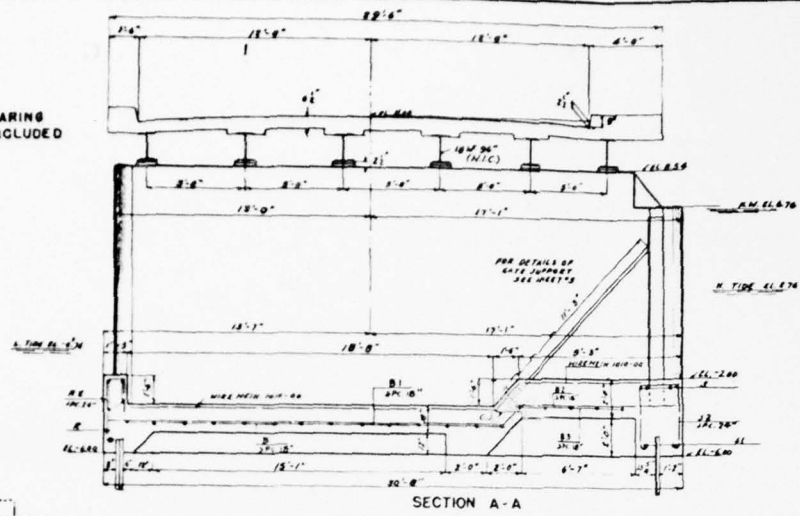


WILLIAMS' POND DAM  
PLAN - PROFILE - BORINGS





NOTE.  
BRIDGE DECK AND BEARING  
PLATES ARE NOT INCLUDED  
IN CONTRACT # 1312



SECTION E-E

REVISIONS

REVISIONS  
1. BEARING  
2. 18' POINTS  
3. BEARING MARKS  
4. CENTERLINE  
5. CENTERLINE

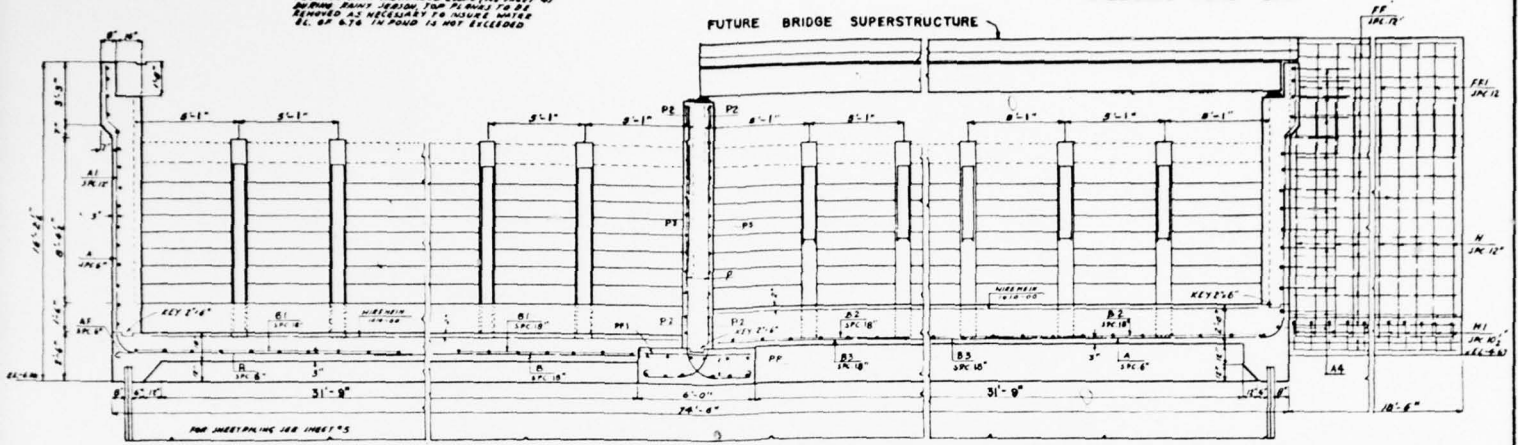


COUNTY	CONTRACT	C. & G. NO.	STATE	FED. AID PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
SUSSEX	1312	2	DEL.			3	5

# WILLIAMS POND DAM

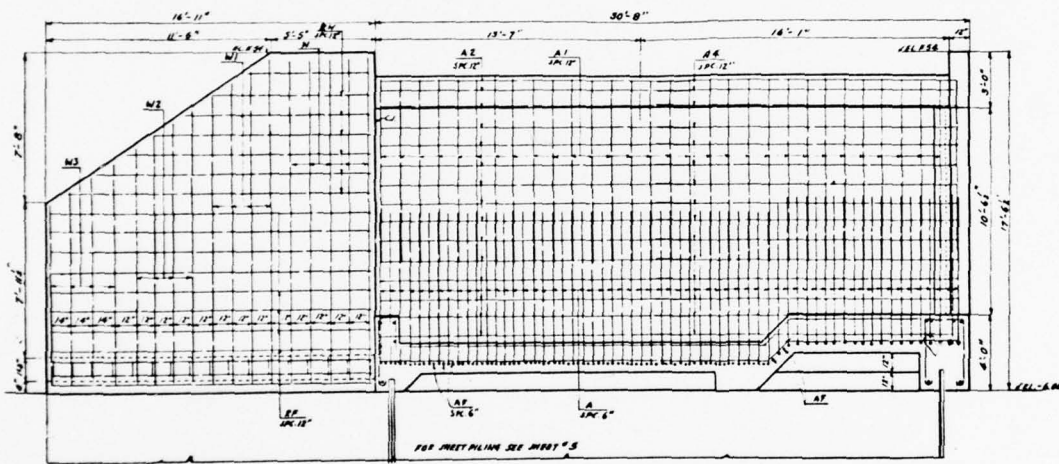
NOTE  
FOUR TOP BARS OF GATE PLANCHES TO BE  
PROTECTED WITH GALVANIZED LEAD (SEE SHEET NO.)  
NOTHING SHOWN BELOW TOP PL. BARS TO BE  
REMOVED AS NECESSARY TO REMOVE WATER  
SL. OF 6.76 IN POND IS NOT EXCLUDED

FUTURE BRIDGE SUPERSTRUCTURE



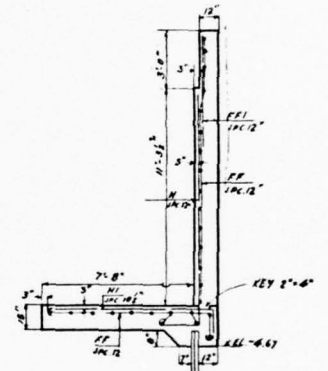
SECTION B-B

SCALE 1/4" = 1'-0"

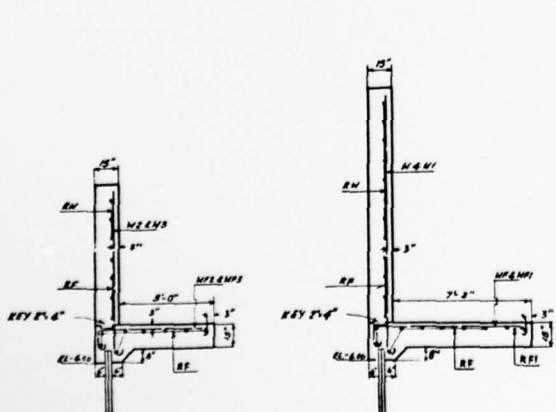


SECTION C-C

SCALE 1/4" = 1'-0"



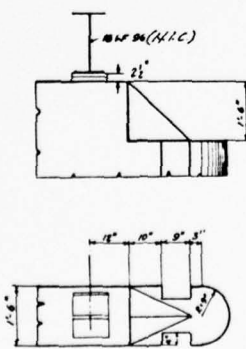
SECTION F-F



SECTION E-E

SCALE 1/4" = 1'-0"

SECTION D-D



PIER DETAIL

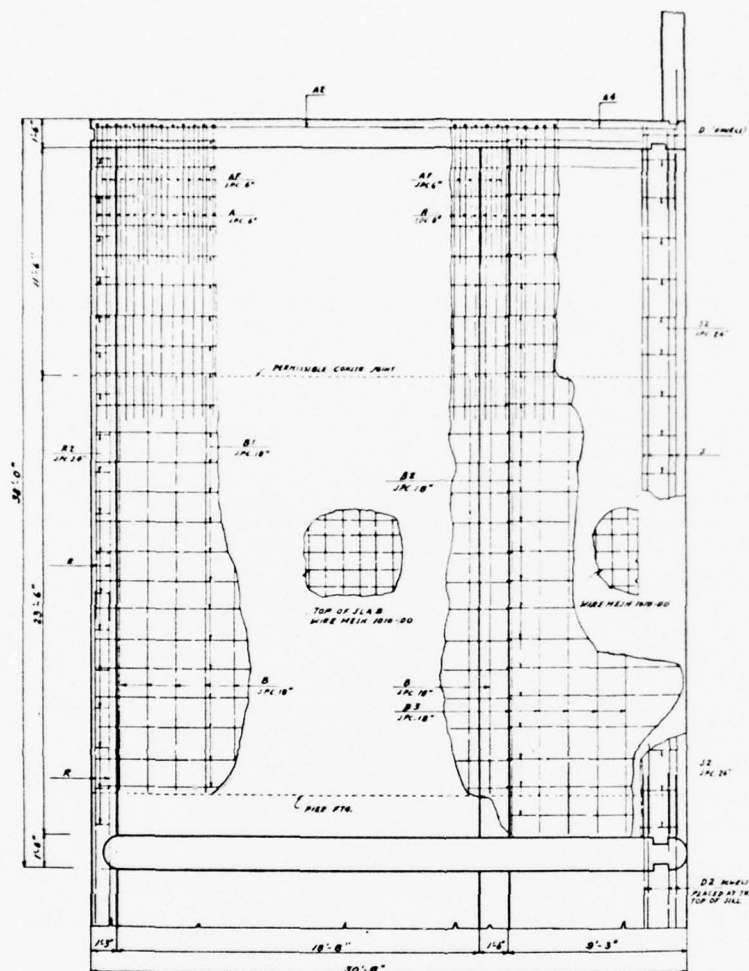
SCALE 1/8" = 1'-0"

DELAWARE STATE HIGHWAY DEPARTMENT		
WILLIAMS POND DAM		
D. W. R. 10/10/12 T. W. R. 10/10/12 CH. 10/10/12	SCALE AS SHOWN	APPROVED BY <i>Joe S. Robman</i> BRIDGE ENGR.



BEARINGS  
 TIE POINTS  
 BENCH MARKS  
 EARTHWORK  
 DRAINAGE

REVISIONS



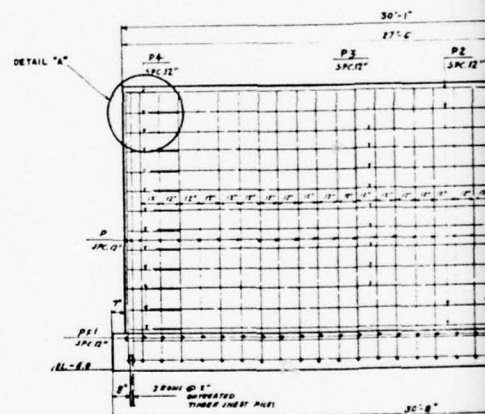
SPILLWAY SLAB REINFORCEMENT  
 SCALE 1/4" = 1'-0"



GATE PLANK DETAIL

SCALE 1" = 1'-0"

NOTE:  
 FOUR TOP ROWS OF PLANKS SHALL HAVE  
 LOOPS AS SHOWN. 112 LOOPS REQUIRED.  
 ALL HARDWARE TO BE GALVANIZED AND  
 SHALL BE PAID UNDER ITEM 20.



PIER ELEVATION



PIER PLAN  
 SCALE 1/4" = 1'-0"







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305 2/10/76 J.E.
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473 2/10/90 J.E.
474 3/



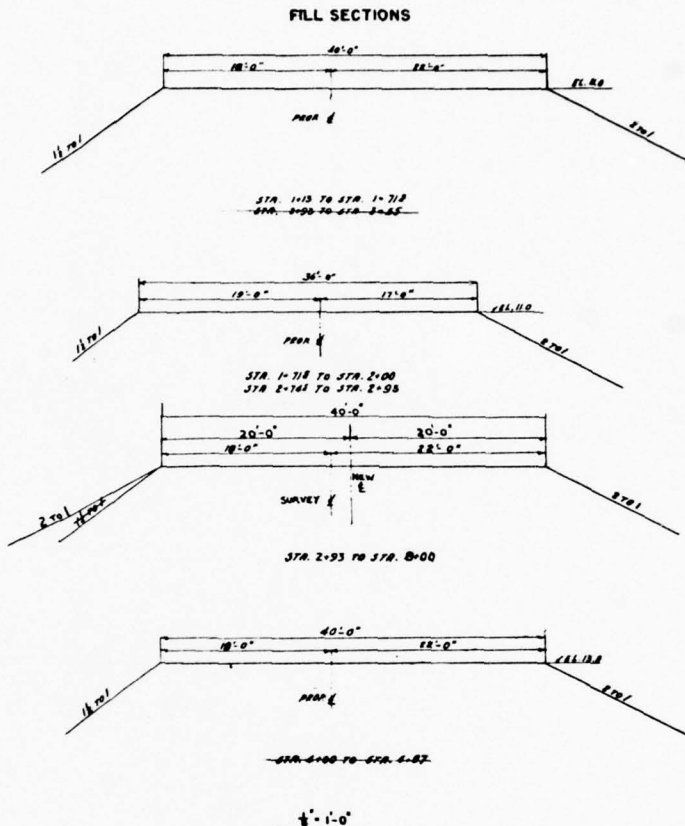
COUNTY	CONTRACT	P. & C. BY NO.	STATE	FED. AID PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
SUSSEX	1312	8	DEL.			5	5

# WILLIAMS POND DAM

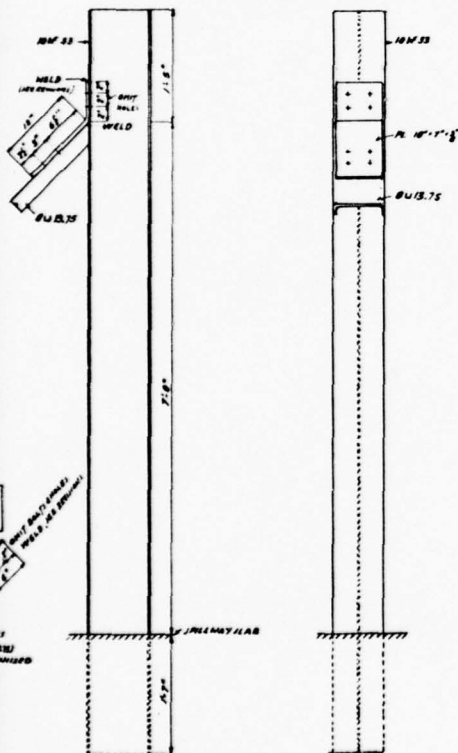
## GENERAL NOTES

THIS STRUCTURE IS LOCATED ON NORTH FORK CREEK NEAR SEAFORD (SEE TITLE SHEET). THE SPECIFICATIONS ARE DATED APRIL 1, 1941 AND ADDENDA DATED MARCH, 1947. WATERPROOFING (SUPERFICIAL) TO BE APPLIED TO THE VERTICAL SURFACE OF WINGS AND ABUTMENTS IN CONTACT WITH EARTH BACKFILL (EXCEPT FOOTINGS). REINFORCING STEEL SPACING C. TO C. BAR. FOR CONSTRUCTION SEQUENCE AND METHODS, SEE SPECIAL PROVISIONS.

DRAINAGE AREA = 23.31 SQ. MI.  
MAX Q = 1300 C.F.S.  
25 YEAR FR.



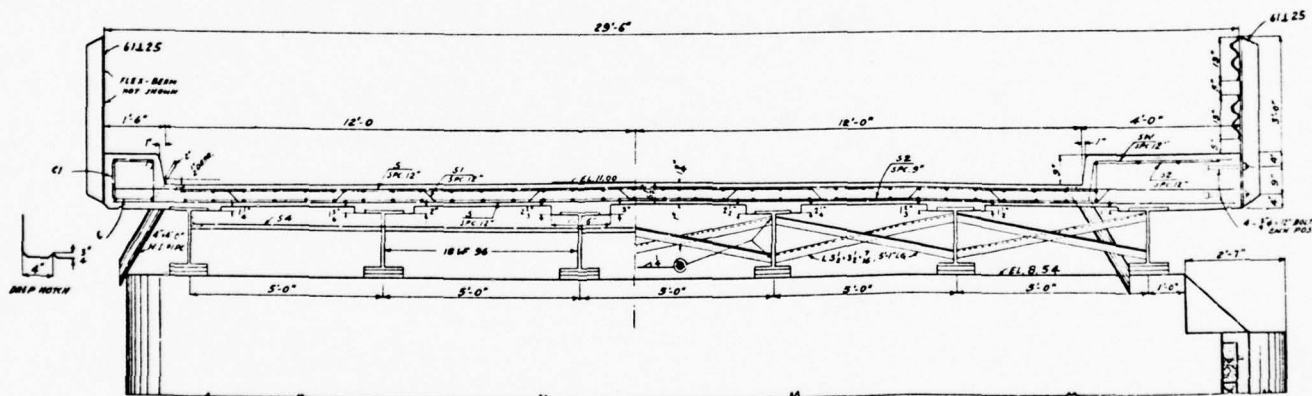
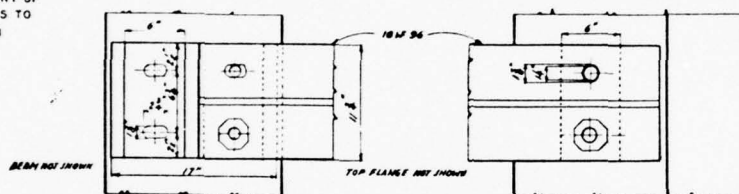
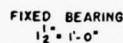
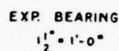
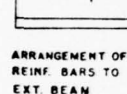
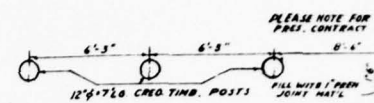
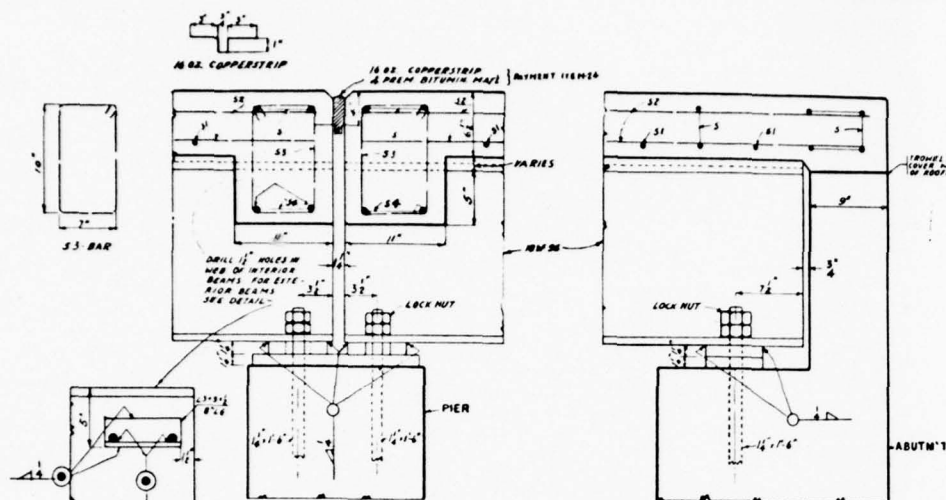
QUANTITIES				
ITEM	DESCRIPTION	UNIT	TOTAL	PROPOSAL
102	CLEARING AND GRUBBING			L.S.
6	EXCAVATION FOR STRUCTURES	C. Y.	1421	1600
7	BORROW	C. Y.	8720	9000
20	CRESOTED TIMBER STRUCTURES	M. FT. B. M.	2,434	2.50
21	CEMENT CONC. MASONRY	C. Y.	322.0	330.0
23	WATERPROOFING (SUPERFICIAL)	SQ. Y.	228	230
24	REINFORCING STEEL (INCL. WIRE MESH)	LBS.	21,540	22,000
26	STRUCTURAL STEEL	LBS.	6257	6300
41	SHEET PILES (LEFT IN PLACE)	M. FT. BM.	9,712	10.00
	STEEL SHEET PILES	LBS	20,630	21,000
	REMOVAL OF STRUCTURES AND OBSTRUCTIONS			L.S.
4	EXCAVATION	C. Y.	295	350



GATE SUPPORT  
7'-0"  
12 REQUIRED

DELAWARE STATE HIGHWAY DEPARTMENT		
WILLIAMS POND DAM		
D. E. S. 10/10/50 T. E. S. 10/10/50 CH. 10/10/50	SCALE AS SHOWN	APPROVED BY <i>Joe S. Robinson</i> BRIDGE ENGR.





SECTION A-A  
1" = 1'-0"

REINFORCING STEEL							
LOCATION	STRAIGHT BARS			BENT BARS			
	NO	SIZE	LENGTH	NO	SIZE	LENGTH	
JEAB (TOP)	78	#5	25'-2" S				
" (BOTTOM)	74	#5	23'-2" S	72	#5	30'-5" JI	
" (IN. T.B.B)	248	#4	19'-6" SJ				
" (AT P.C. BEAM)	4	#6	24'-8" S-4	50	#4	6'-0" SJ	
CURB (IN.)	16	#5	13'-6" SJ	76	#4	5'-0" C	
SIDE WALK (IN.)	24	#4	19'-6" C2	76	#4	6'-5" SJ	

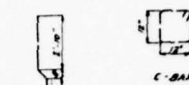
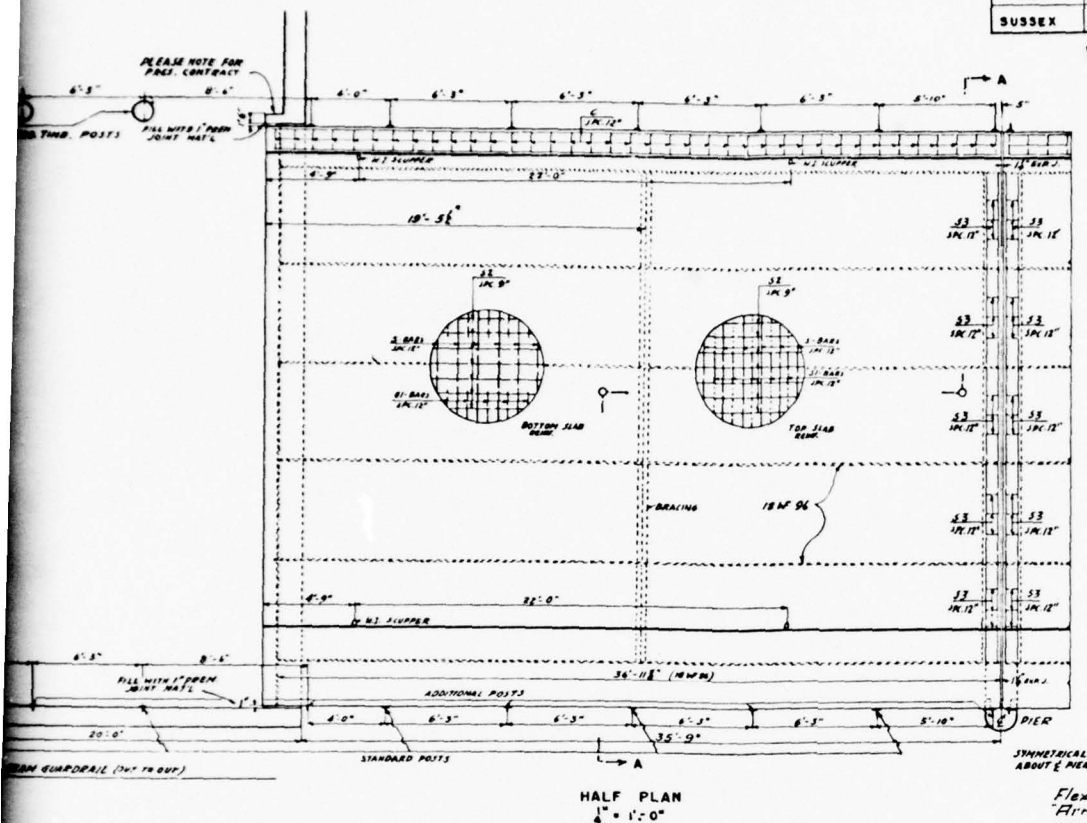
Q U A N T I T I E S			
ITEM	D E S C R I P T I O N	UNIT	TOTAL
21	CON. CONC. MAISONRY	C.Y.	618
24	REINF. STEEL	LBS.	11,593
26	STRUCTURAL STEEL (INCL. BEARING @ 4 WAYWARD BOLTS)	LBS.	45,275
	FLEX-BEAM GUARDRAIL (INCL. CRAD TING @ 370 STEEL POSTS)	L.F.	2310

APPROVED: W.A. McWilliams  
By: J.B. Baron CHIEF ENGINEER



COUNTY	CONTRACT	F. & A. NO.	STATE	FED. AID PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
SUSSEX	1312 ADDITION		DEL.			5	6

WILLIAMS POND DAM  
BRIDGE SUPERSTRUCTURE  
ADDITION TO CON. 1312



NOTES  
For general notes, refer to sheet #5.

Flex-beam guard rail shall conform with current AASHTO specifications. Paint and painting shall be as specified for structural steel. Payment for guard rail complete in place shall include creosoted timber and structural steel posts, attachments, and incidentals, as well as all painting specified.

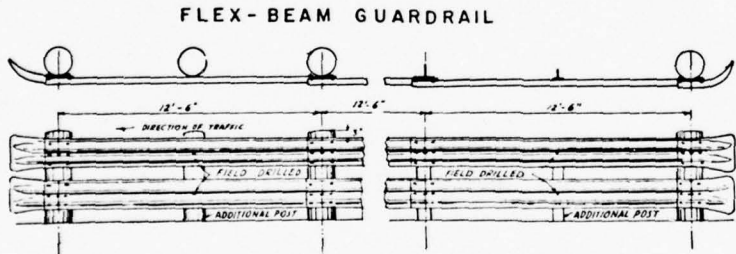
Please note spacing of guard rail posts. Use standard 12'-0" lengths of Flex-beam, and drill holes for additional posts in the field.

Concrete in the roadway slab shall meet the requirements of Item 16 - Cement Concrete Pavement, as regards screeding by hand methods, finishing, straight edging, floating, finishing with burlap, curing, and sealing of joints and cracks. Payment for wrought-iron scuppers shall be included in the price submitted for Concrete Deck.

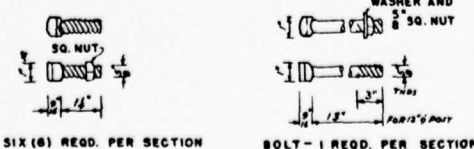
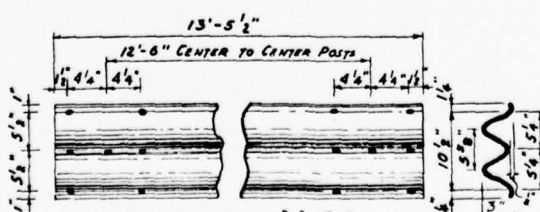
Structural Steel shall conform with requirements of Item 26 of the Standard Specifications, with the following exceptions noted.

Paragraphs 26.3 and 26.4 are deleted. Paint and painting shall conform with the standard paint specifications of the State Highway Department currently in use.

Welding shall conform with the Standard Specifications for Welded Highway and Railway Bridges of the American Welding Society, dated 1947, with current addenda.



ELEVATION



DELAWARE STATE HIGHWAY DEPARTMENT	
WILLIAMS POND DAM BRIDGE SUPERSTRUCTURE	
DR. R.R. 12/16/55 TR. R.R. 12/16/55 CH. R.R. 12/16/55	SCALE AS SHOWN
APPROVED BY <i>Joe S. Robinson</i> BRIDGE ENGR.	



REVISIONS

CHECKED
GRADE
BEARINGS
TIE POINTS
SECTION MARKS
STATIONING
DRAINAGE

MANTICONE MEMORIAL HOSPITAL

HIGH ST.  
TO NEWFORD  
TO SEAFORD

WILLIAMS POND

PI 5+00.00  
A 36+54.1  
D 12+00.0  
L 124.69  
L 239.17

AC 3+45.22

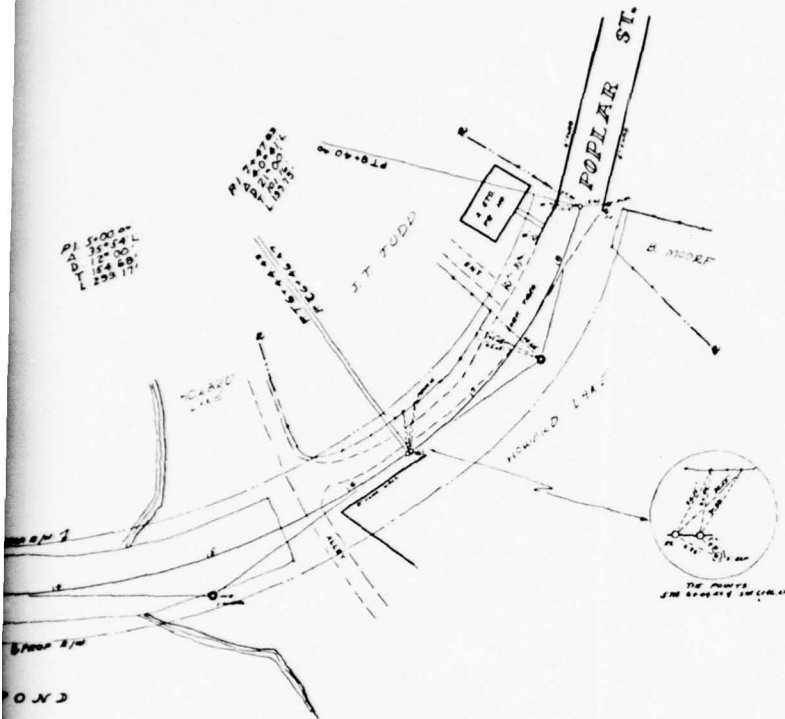
PROP 2/14

PROP 2/14



COUNTY	CONTRACT	C. & G. EST. NO.	DATE	FED. AID PROJECT NO.	FED. AID FISCAL YEAR	STATE FISCAL YEAR	LOCAL FISCAL YEAR
SUSSEX	1312	2	DEL.				

POPLAR STREET EXT. (Seaford)





Lippincott Engineering Associates

501 Burlington Avenue  
 DELANCO, NEW JERSEY 08075  
 Area Code (609) 461-1239

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

RT. 535 BRIDGE AND CULVERT DETAIL

ALUMINUM RAIL

AVG. ROAD SURFACE EL. 12.46

CONC. DECK

STEEL BEAM

AVG. OVERT EL. 8.96

HIGH TIDE ELEV. 2.76

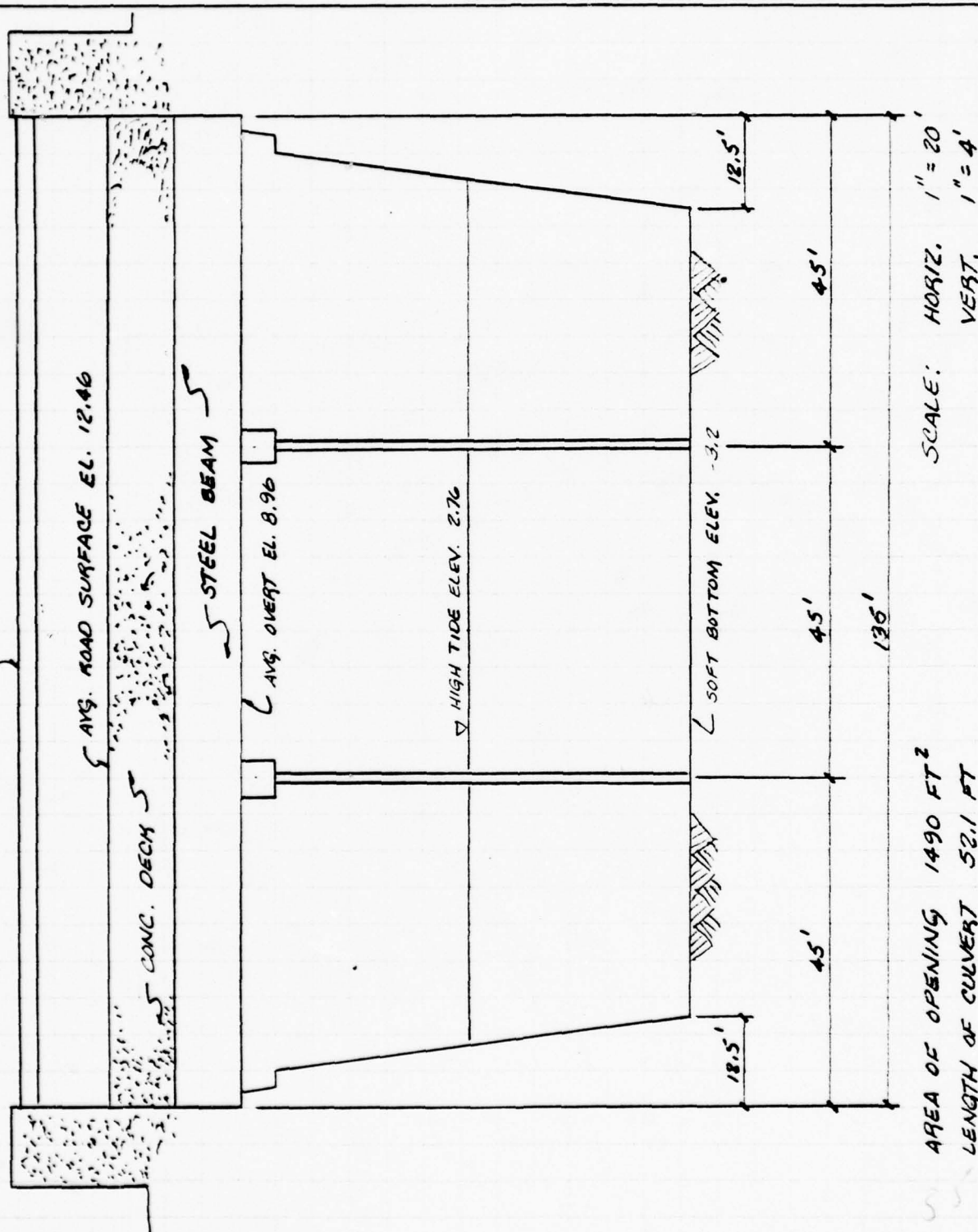
SOFT BOTTOM ELEV. -3.2

ELEVATION (M.S.L.)

PLATE #14

SCALE: HORIZ. 1" = 20'  
 VERT. 1" = 4'

AREA OF OPENING 1490 FT<sup>2</sup>  
 LENGTH OF CULVERT 52.1 FT





## GEOLOGY

According to our phone conversations with Mr. Robert R. Jordan, State Geologist with Delaware Geological Surveys, the geology of the Williams Pond area has not been mapped for publication as of this writing. In lieu of geologic maps, a copy of the Sussex County Soil Conservation Map has been enclosed. Mapping is as shown on the plan with descriptions as noted below. Copies of the boring logs of the dam site are provided in the dam construction drawings, Sheet numbers 6 through 13 listed in "Plates".

### Soil Descriptions

- EsD - Evesboro loamy sand - 5 to 15% slopes - >95% of lake shores  
(north side embankment)
- Tf - Tidal marsh - fresh water - downstream channel
- EvB - Evesboro loamy sand and loamy substratum - 0 to 5% slopes  
one side of embankment (south) - <5% lake shores.







APPENDIX A



Check List  
Visual Inspection  
Phase 1

Name Dam Williams Pond County Sussex State Delaware Coordinators Krishna A. Patel  
Div. Engr. Del.  
Dept. of Natural  
Resources &  
Environmental  
Control

Date(s) Inspection 7 December 1978

Weather Clear

Temperature 45°

Pool Elevation at Time of Inspection 7.5' M.S.L.

Tailwater at Time of Inspection + 0.6 M.S.L.

Inspection Personnel:

Daniel W. Jacobs, P.E.

Joseph Mahan, P.E.

Daniel W. Jacobs, P.E. Recorder



# CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	None observed.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Minor erosion upstream side from surface water flowing off roadway. Minor erosion downstream side from surface water flowing off roadway and effect of tide.	Consider riprap and/or paving upstream and downstream to repair and stabilize erosion.
DRAINS	Road drains are functioning well No problems observed.	
WATER PASSAGES	Clear and free flowing.	
FOUNDATION	North downstream bridge wingwall tilting backward into bank by approximately 7". Appears that bottom has slid out at water line by 1"-no other signs of movement. Wingwall appears stable.	



# CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Concrete good condition - egg shell cracking in bridge deck surface	A surface treatment may be considered
STRUCTURAL CRACKING	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT	No problems observed.	
MONOLITH JOINTS	No problems observed.	
CONSTRUCTION JOINTS	No problems observed.	



# EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Downstream behind wings, soil erosion See photos - eroded approximately 2 to 3 feet deep.	Consider riprap for upstream & downstream embankments adjacent to each side of the bridge to stabilize these slopes.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems observed.	
RIPRAP FAILURES	None observed.	



# EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Minor erosion up and downstream each side of bridge.	Consider stabilization using riprap.
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	Appeared clean and clear.	



# OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	Minor damage between stoplogs but are not tight.	Consider replacement of damaged stoplogs.
OUTLET STRUCTURE	No problems observed.	
OUTLET CHANNEL	No problems observed.	
EMERGENCY GATE	None.	



# UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE WEIR

N/A

APPROACH CHANNEL

N/A

DISCHARGE CHANNEL

N/A

BRIDGE AND PIERS

N/A



# GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE SILL

None.

APPROACH CHANNEL

No problems observed.

DISCHARGE CHANNEL

No problems observed.

BRIDGE AND PIERS

See comments on downstream wingwalls.

Wingwalls appear to be stable.

GATES AND OPERATION  
EQUIPMENT



# INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER		



# RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

## SLOPES

No problems observed.

## SEDIMENTATION

No problems observed.



# DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONDITION  
(OBSTRUCTIONS,  
DEBRIS, ETC.)

No large deposits of debris observed.  
No problems observed.

SLOPES

No problems observed.

APPROXIMATE NO.  
OF HOMES AND  
POPULATION

Approximately 6 homes between dam and the  
Nanpicoke River. Population estimated @  
30 -. See Photos

Homes are located on high ground  
ranging from 5' to 10' above the  
downstream channel. Failure of  
the dam would not appear to result  
in damage to homes.



**CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION**

ITEM	REMARKS
<b>PLAN OF DAM</b>	A set of construction drawings is available from the Delaware State Highway Department, titled, Plans For Contract 1312, Dated Oct. 27, 1953. As-built survey of January, 1979, showing centerline profiles and bridge inlet area included in this report.
<b>REGIONAL VICINITY MAP</b>	See location plan included in this report. Dam was constructed in 1954 under contract to the Delaware State Highway Department.
<b>CONSTRUCTION HISTORY</b>	Dam was constructed in 1954 under contract to the Delaware State Highway Department.
<b>TYPICAL SECTIONS OF DAM</b>	The structural aspects of the bridge - some data was available from the Highway Department. Plans as referenced above - sections on the earth embankment were not available.
<b>HYDROLOGIC/HYDRAULIC DATA</b>	- See hydrologic and hydraulic data check list.
<b>OUTLETS - PLAN</b>	- Plans above referenced indicated the size of type of outlet control section.
<b>- DETAILS</b>	- included in Delaware State Highway Plans
<b>- CONSTRAINTS</b>	
<b>- DISCHARGE RATINGS</b>	- The only data available was derived from the HEC-1 DB program using data input from L.E.A. which was derived using standard engineering methods.
<b>RAINFALL/RESERVOIR RECORDS</b>	- None in immediate vicinity of dam.



ITEM	REMARKS
------	---------

DESIGN REPORTS	N/A
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GEOLOGY REPORTS - None available - see section in Plate Section of Appendix.

DESIGN COMPUTATIONS - N/A  
 HYDROLOGY & HYDRAULICS - N/A  
 DAM STABILITY - N/A  
 SEEPAGE STUDIES - N/A

MATERIALS INVESTIGATIONS - N/A  
 BORING RECORDS - Shown on Sheet 2 of Highway Plans as previously referenced.  
 LABORATORY - N/A  
 FIELD

POST-CONSTRUCTION SURVEYS OF DAM - Completed as a part of the Phase I Inspection, January 1, 1979.

BORROW SOURCES - Not shown on engineering drawings from Delaware State Highway Department - unknown.



ITEM	REMARKS
------	---------

SPILLWAY PLAN - Delaware State Highway Department Plans - 7 Sheets.

SECTIONS - Same as above.

DETAILS - Same as above.

OPERATING EQUIPMENT  
PLANS & DETAILS -

Original installation plans available for gates. Visual observation indicates as-built condition similar to design drawings.



ITEM	REMARKS
------	---------

MONITORING SYSTEMS - None observed.

MODIFICATIONS - Slight improvements to both side of embankment to halt surface erosion condition.

HIGH POOL RECORDS N/A

POST CONSTRUCTION ENGINEERING N/A  
STUDIES AND REPORTS

PRIOR ACCIDENTS OR FAILURE OF DAM - Willard Griffith, Superintendent, Gravel Hill Maintenance Division,  
DESCRIPTION Delaware State Highway Department reports that there are none.  
REPORTS

MAINTENANCE - Bi-annual inspection reports are kept by Delaware State Highway Department, Bridge Division,  
OPERATION at Dover. No records of actual maintenance operations are kept.  
RECORDS



Appendix B



### PHOTOGRAPHIC INDEX

- Photo 1 - View of Poplar Street Bridge over Williams Pond Dam.  
Shot taken from south side of embankment.
- Photo 2 - Closeup of Photo 1 showing the west side rail and  
road drainage discharge pipe on the downstream side.
- Photo 3 - Wide angle view of upstream homes along the south  
side of the lake shore.
- Photo 4 - Right side angle view from downstream of Williams  
Pond Dam - wide angle view - note eroded condition  
on the north side embankment.
- Photo 5 - Full front view of Williams Pond Dam from downstream.
- Photo 6 - Left side angle view of Williams Pond Dam from  
downstream.
- Photo 7 - Closeup view of stoplog inlets and gate supports.  
Note damaged condition of stoplogs.
- Photo 8 - Closeup view of eroded embankment condition upstream  
side, Williams Pond Dam.
- Photo 9 - Closeup view of erosion control measures on upstream  
side of Williams Pond Dam embankment.
- Photo 10 - View of Hearn's Pond embankment roadway located 7140  
feet upstream of Williams Pond Dam.
- Photo 11 - View of Mill Race inlet structure, Hearn's Pond upstream  
side of dam embankment.
- Photo 12 - Mill buildings located over top Mill Race sluice  
through Hearn's Pond embankment.
- Photo 13 - Side view of Hearn's Pond Dam - main road dam inlet area.
- Photo 14 - Closeup of upstream inlet control at Hearn's Pond main  
road dam structure.

Note: All photographs taken 12-7-78.



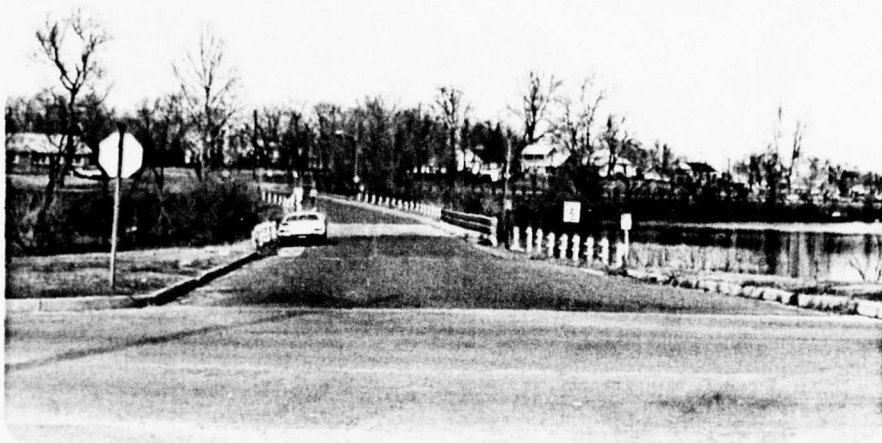


PHOTO 1  
 Poplar Street Over Williams  
 Pond Dam



PHOTO 2  
 Closeup of Above Showing Railroad  
 Drainage Discharge Pipe-Downstream



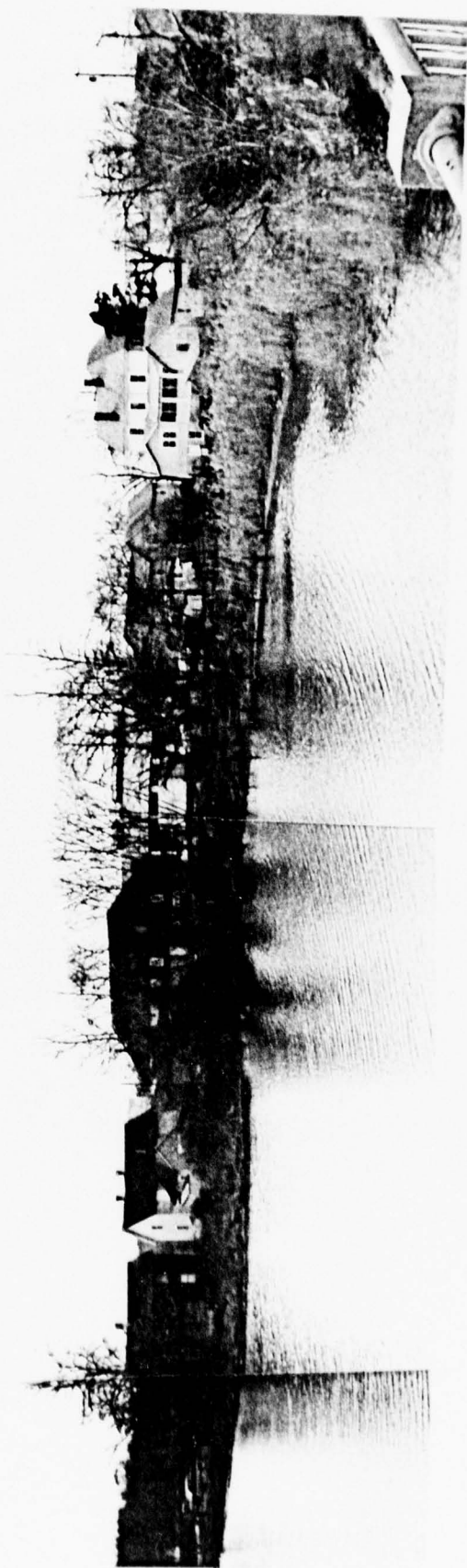


PHOTO 3

Williams Pond - Upstream Homes



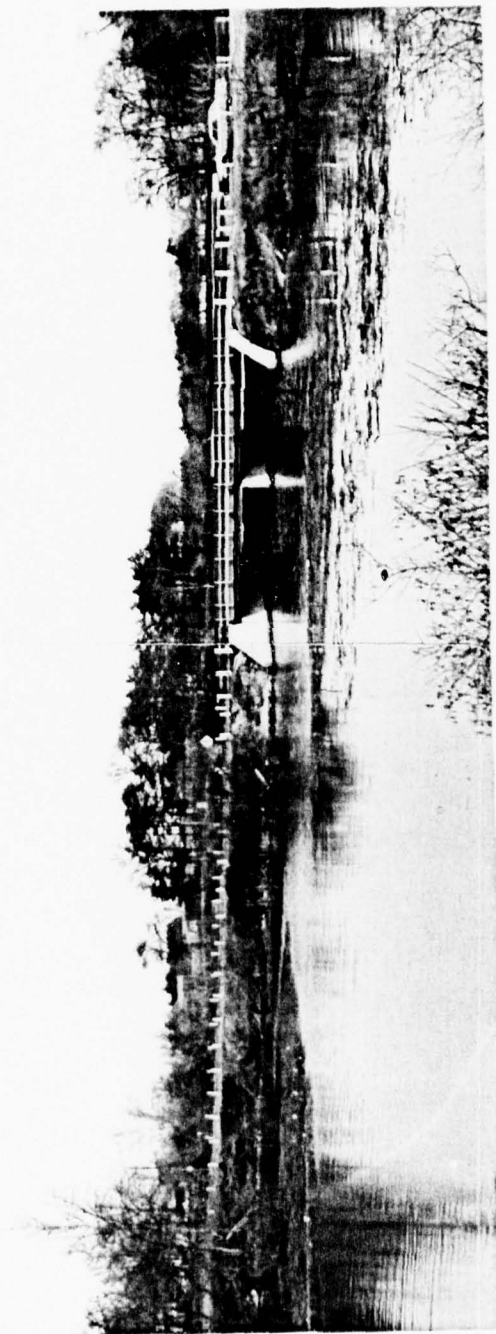


PHOTO 4  
Downstream View - Williams Pond  
and Embankment





PHOTO 5  
Downstream View-Williams Pond Dam



PHOTO 6  
Downstream View-Williams Pond Dam



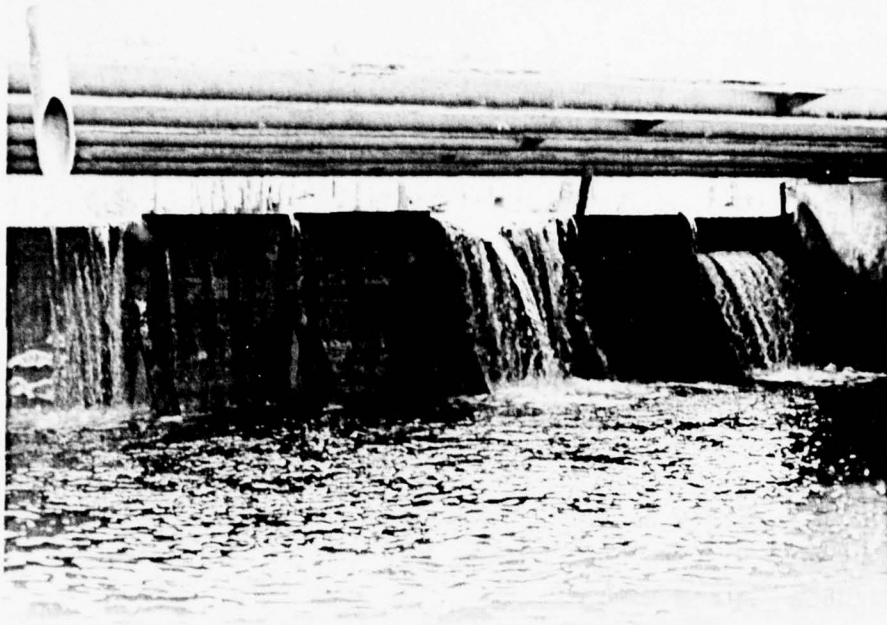


PHOTO 7  
Closeup of Stoplogs & Gate Support  
System-Downstream-Williams Pond Dam



PHOTO 8  
Eroded Upstream Embankment  
Williams Pond



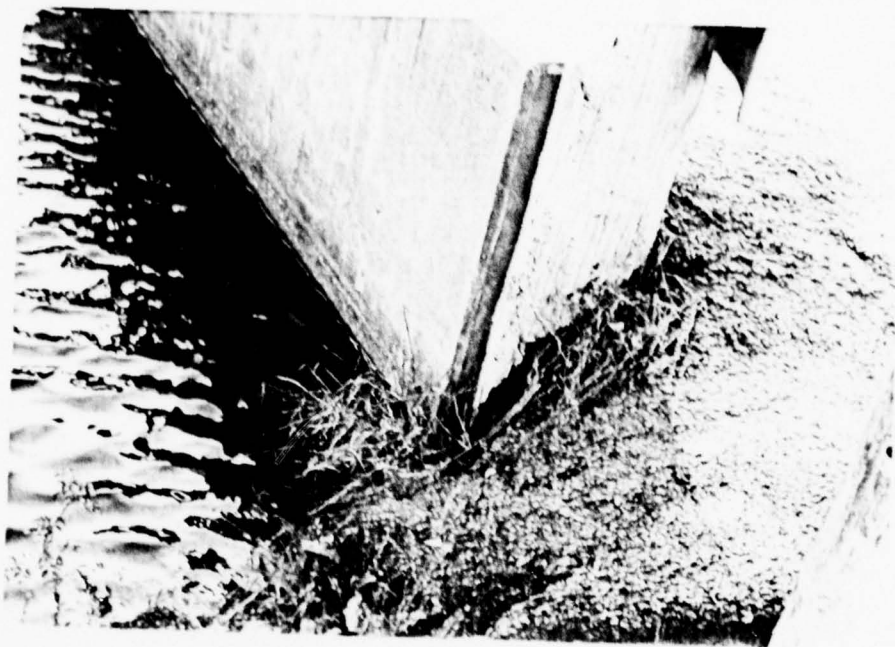


PHOTO 9  
 Bituminous Paving Installed To  
 Correct/Prevent Erosion-Williams  
 Pond



PHOTO 10  
 Hearnis Pond Mill Road Over  
 Embankment and Dams - 7140 Feet  
 Upstream of Williams Pond



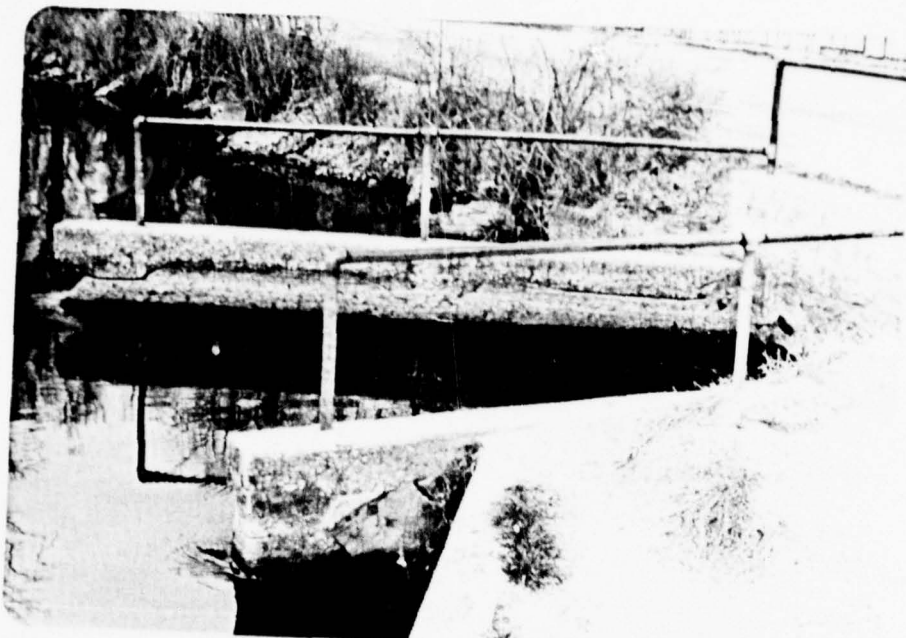


PHOTO 11  
Hearn Pond Mill Inlet

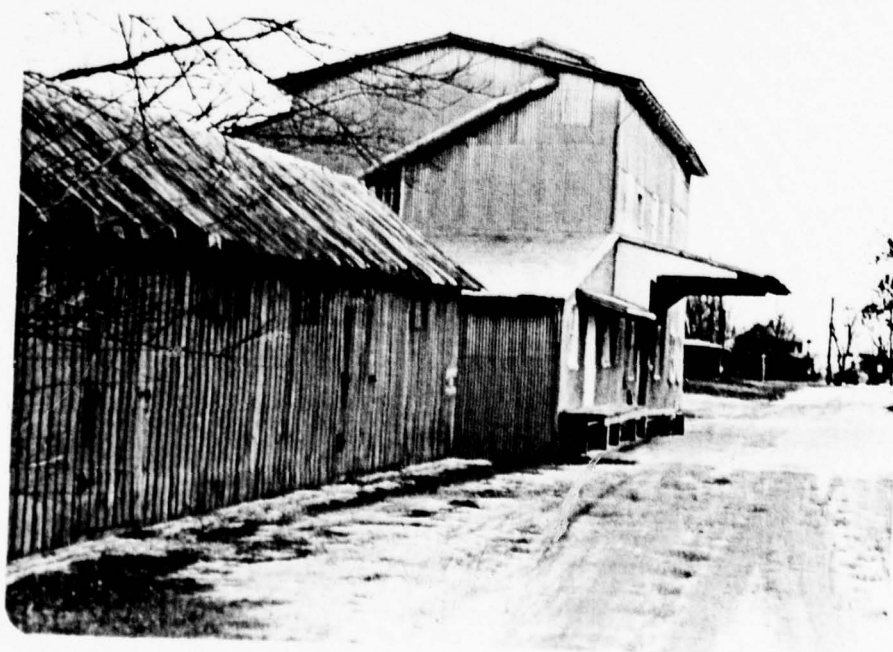


PHOTO 12  
Hearn Pond Mill Building





PHOTO 13  
Upstream View-Hearn's Pond & Dam

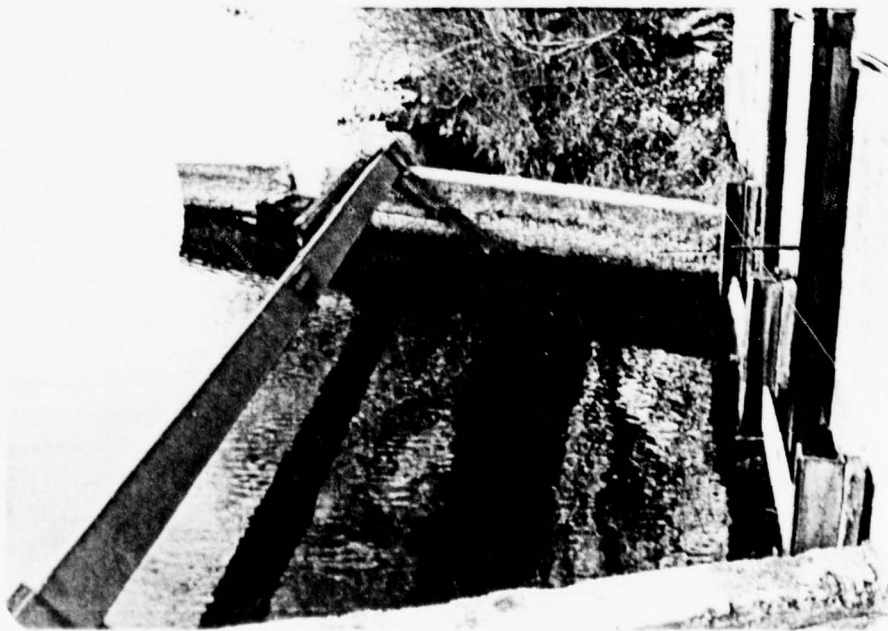


PHOTO 14  
Upstream View - Hearn's Pond Dam



APPENDIX C



CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 13.40 + 9.83 = 23.23 Square Miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 425 Acre-Feet

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 800 Acre-Feet

ELEVATION MAXIMUM DESIGN POOL: 14.3  $\pm$  feet M.S.L.

ELEVATION TOP DAM: 12.0  $\pm$  feet M.S.L.

CREST: Gate (stoplogs @ bridge)

- a. Elevation 7.5 M.S.L.
- b. Type Wood
- c. Width 3 inches -negligible
- d. Length 12 sections - 5 ft. wide = 60 ft; 9 stoplogs per section
- e. Location Spillover None
- f. Number and Type of Gates SEE BELOW

OUTLET WORKS: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Entrance inverts \_\_\_\_\_
- d. Exit inverts \_\_\_\_\_
- e. Emergency draindown facilities \_\_\_\_\_

HYDROMETEOROLOGICAL GAGES: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: \_\_\_\_\_

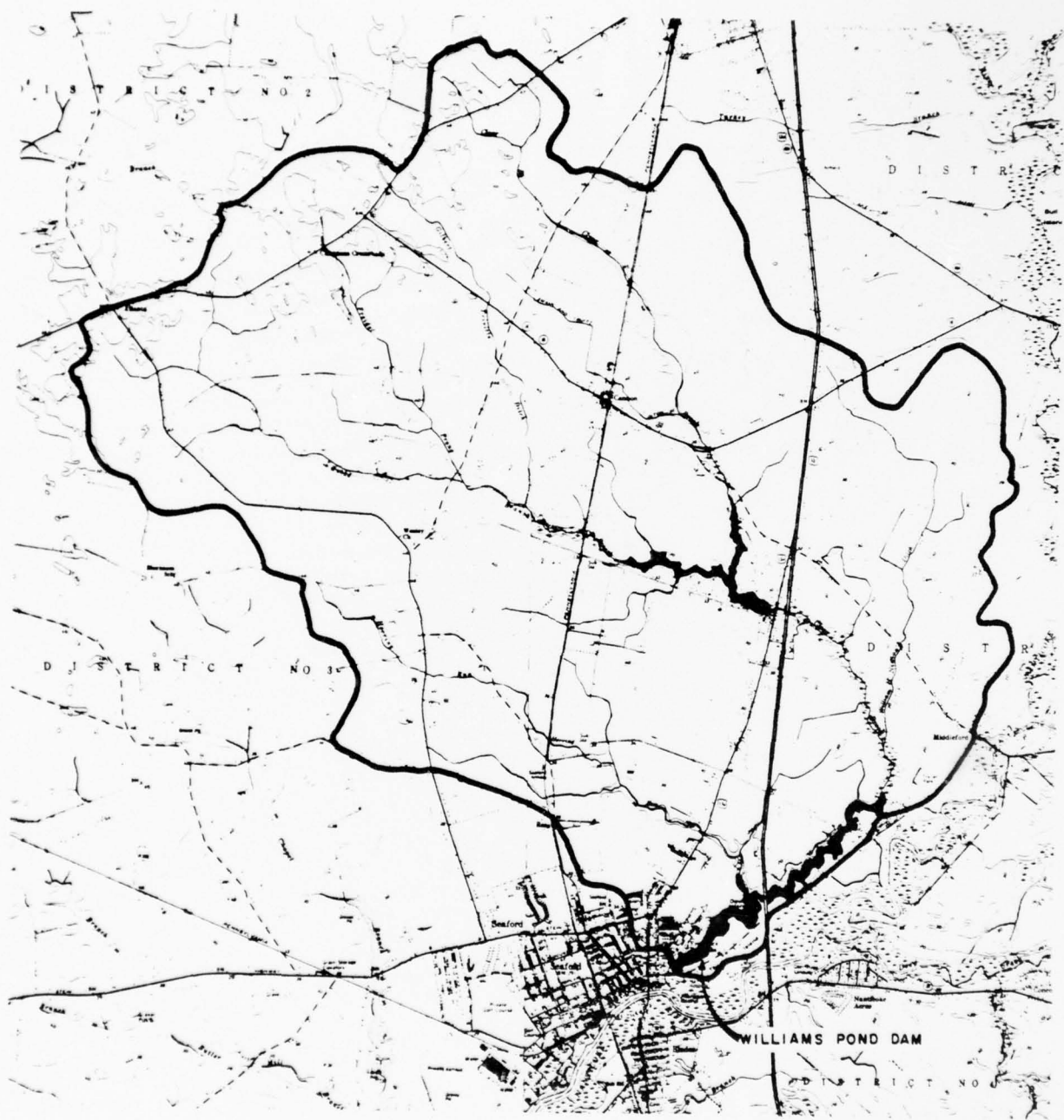
CREST:

- f. 12 sections, 4 removable (top-most) stoplogs per section, thus a total of 48 removable stoplogs. The remaining stoplogs (approx. 60) do not have hooks attached for them to be removable.



Appendix D





WATERSHED MAP

WILLIAMS POND DAM



Lippincott Engineering Associates

501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

JOB 2089 HEARN POND DAM

SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

HEARNS POND

$$\begin{aligned} T.P. &= Ct (L \times L_{CA})^{0.3} \\ &= 3.0 (5.49 \times 2.37)^{0.3} \\ &= 6.5 \text{ HRS} \end{aligned}$$

WATER SURFACE AREA = 2,600,000 FT<sup>2</sup>

AREA WITHIN ELEV. 30 = 7,680,000 FT<sup>2</sup>



Lippincott Engineering Associates

501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

JOB 2089 HEARN'S POND DAM

SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

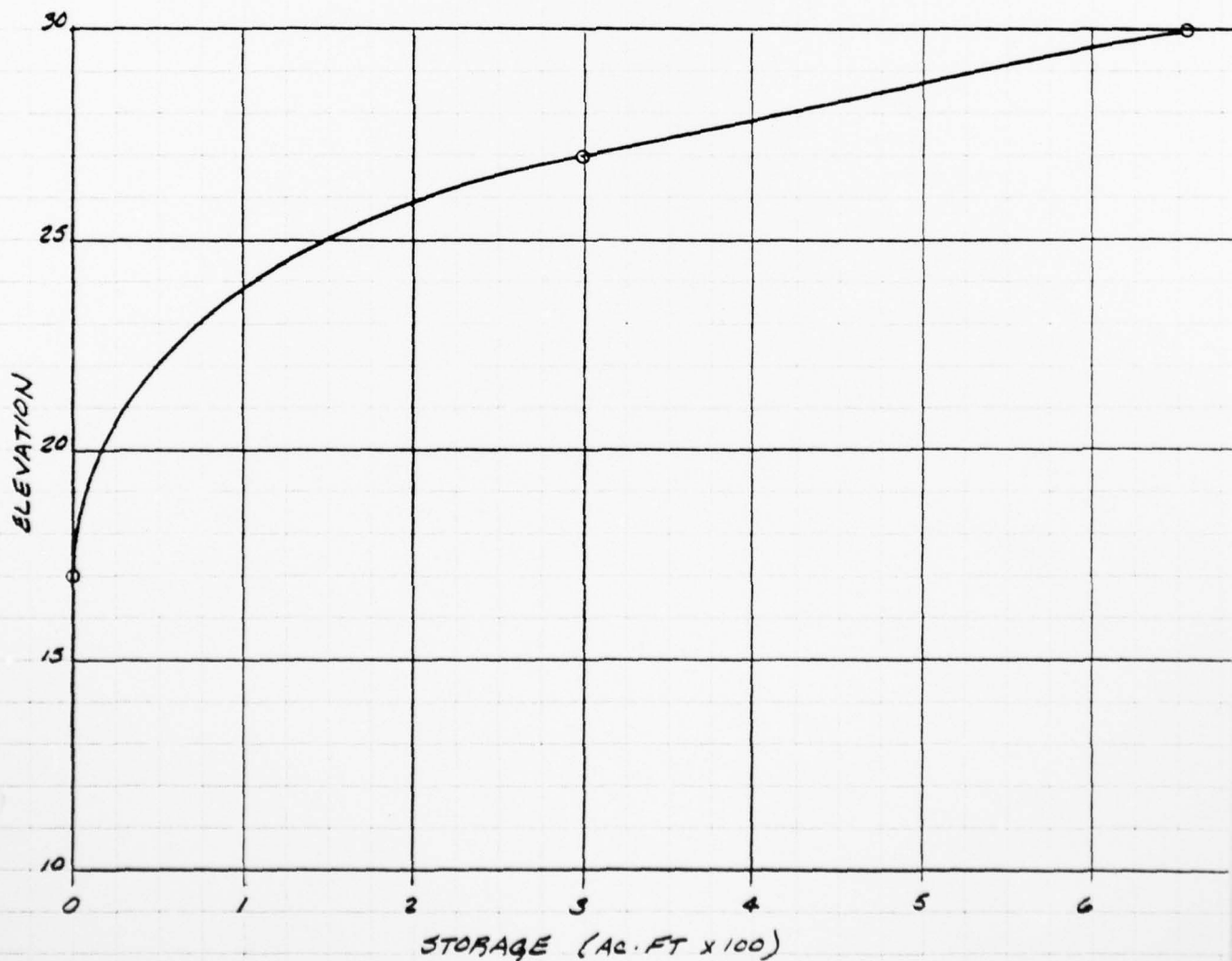
CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

ELEV	AREA (FT <sup>2</sup> )	AVG AREA (FT <sup>2</sup> )	DEPTH	VOLUME (FT <sup>3</sup> )	Σ VOLUME (FT <sup>3</sup> )	Σ VOLUME (FT)
17	0				0	0
		1,300,000	10	13,000,000		
27	2,600,000				13,000,000	298.4
		5,140,000	3	15,420,000		
30	7,680,000				28,420,000	652.4

STAGED STORAGE CURVE





# Lippincott Engineering Associates

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DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

JOB 2089 HEARN'S POND DAM

SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

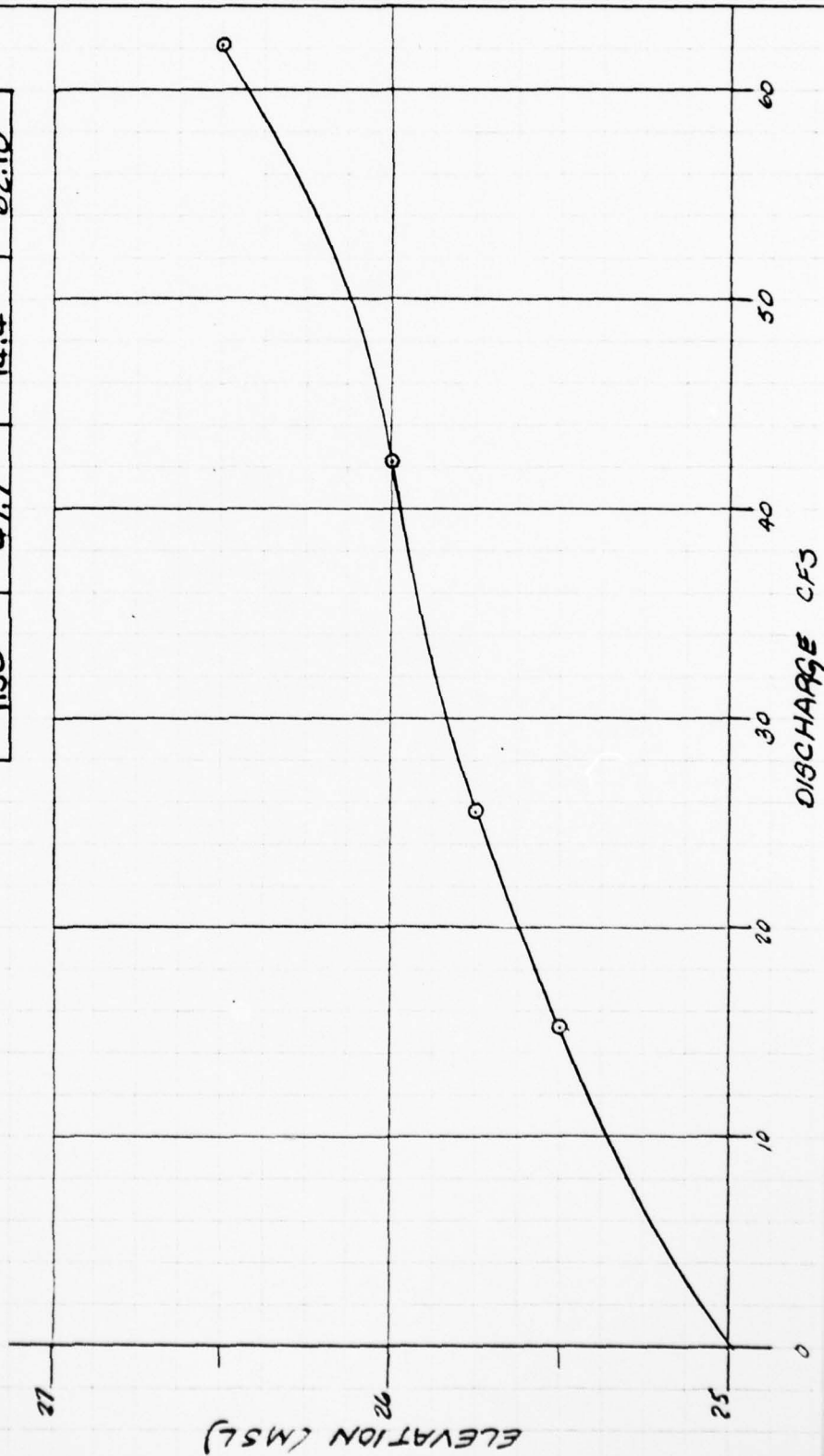
SCALE \_\_\_\_\_

## STAGED DISCHARGE - BOARDS IN - HEARN'S POND

H	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>TOTAL</sub>
.50	11.66	3.52	15.18
.75	19.61	5.92	25.52
1.00	31.8	10.5	42.30
1.50	47.7	14.4	62.10

Q<sub>1</sub> = FLOW AT MAIN STRUCTURE

Q<sub>2</sub> = FLOW AT MILL RACE





Lippincott Engineering Associates

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JOB 2089 HEARN'S POND DAM

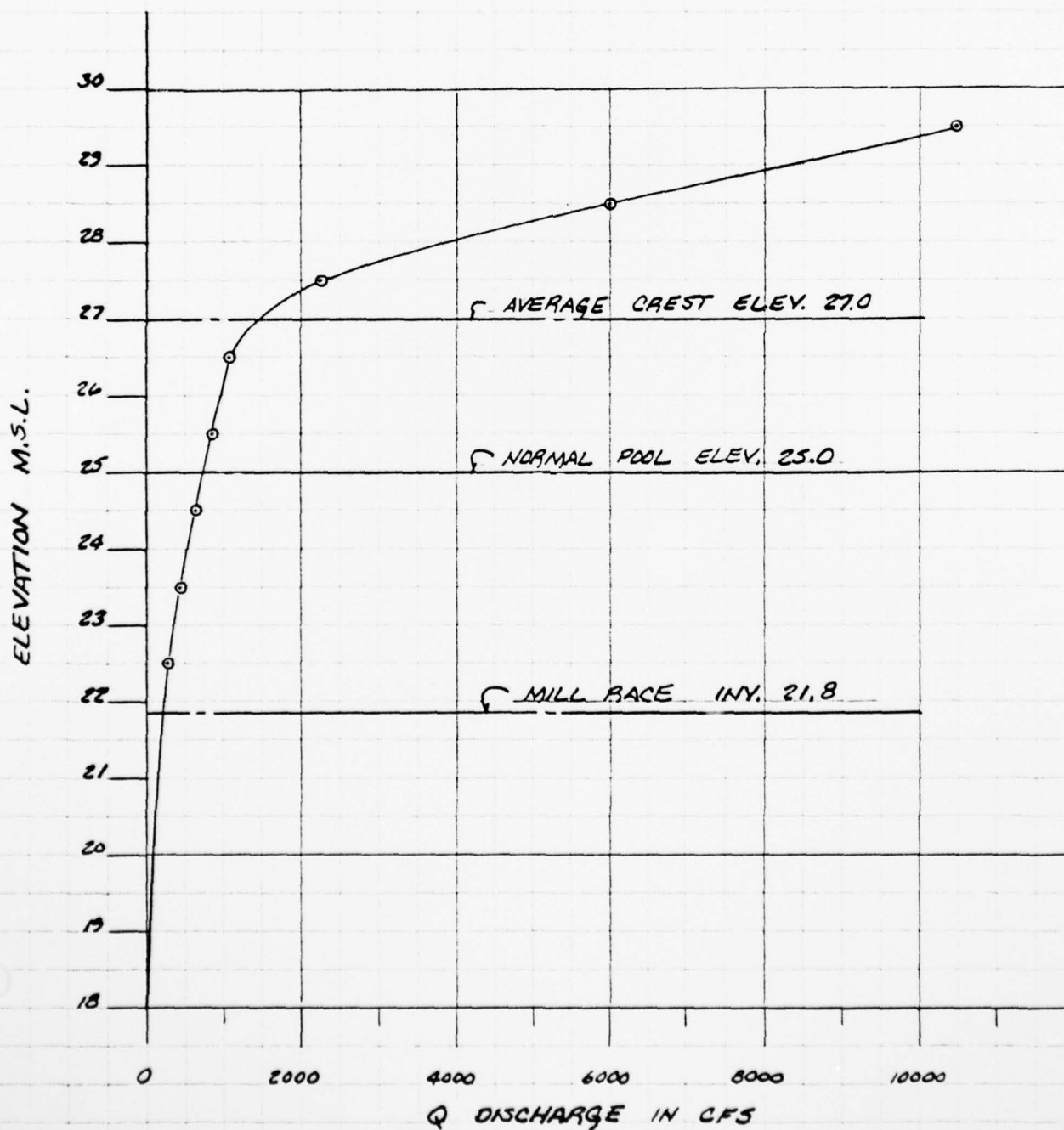
SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

**TOTAL DISCHARGE - HEARN'S POND COMBINED  
ALL BOARDS OUT**





Lippincott Engineering Associates  
501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

JOB 2089 WILLIAMS POND DAM  
SHEET NO \_\_\_\_\_ OF \_\_\_\_\_  
CALCULATED BY \_\_\_\_\_ DATE 2/79  
CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
SCALE \_\_\_\_\_

WILLIAMS POND

$$\begin{aligned} T.P. &= C_t (L \times L_{CA})^{0.3} \\ &= 3.0 (5.73 \times 2.70)^{0.3} \\ &= 6.8 \text{ HRS} \end{aligned}$$

FROM DELAWARE STATE HIGHWAY DEPT.  
PLANS FOR CONTRACT N<sup>o</sup> 1312 10/28/78

- A) DROP BOARD DAM
- B) NORMAL POOL ELEV. 7.5
- C) HIGH TIDE ELEV. 2.76
- D) LOW TIDE ELEV. -0.76
- E) BOTTOM BOARD ELEV. -2.00



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DELANCO, NEW JERSEY 08075  
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JOB 2089 WILLIAMS POND DAM

SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

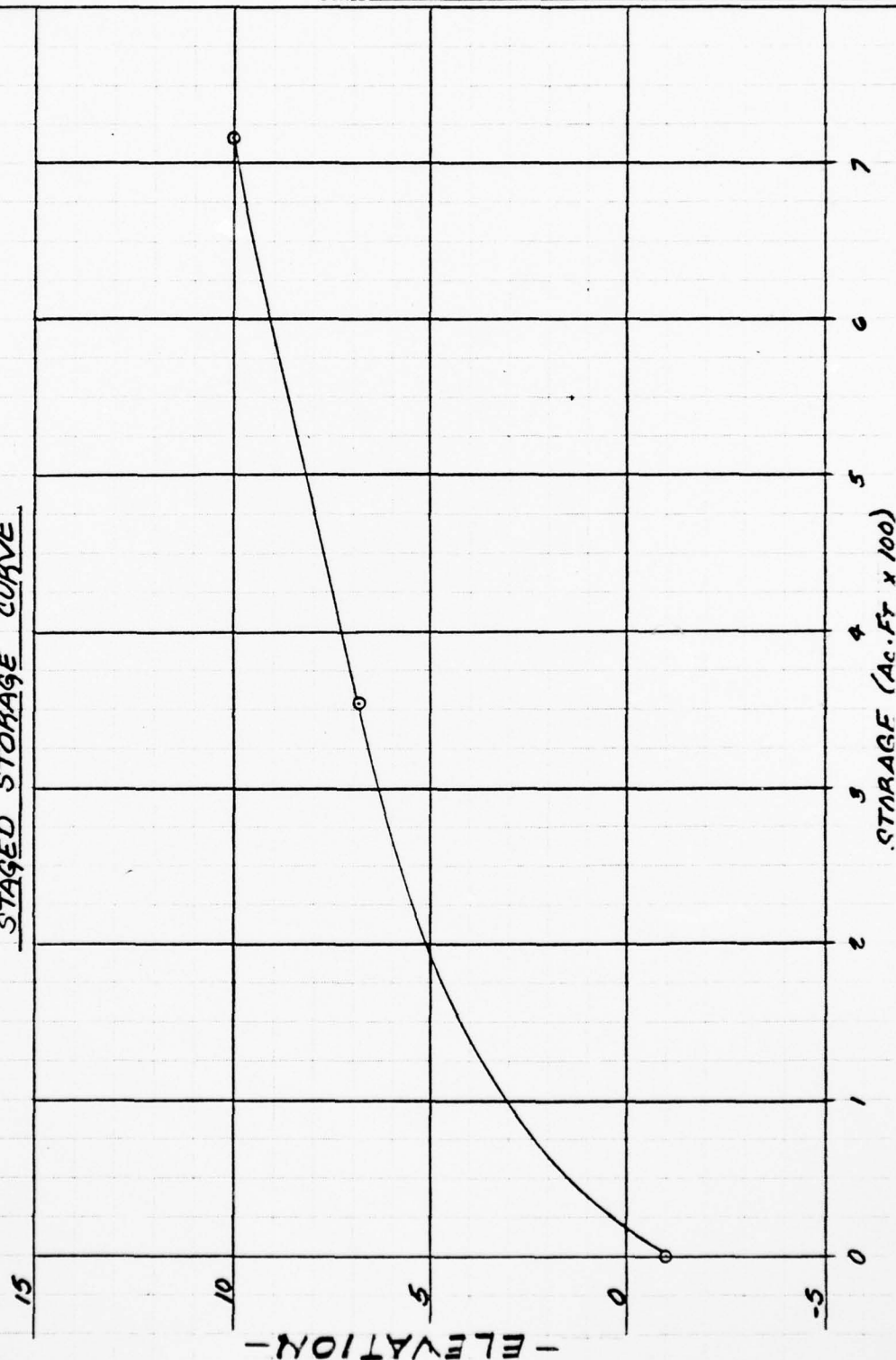
CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

ELEV.	AREA (FT <sup>2</sup> )	AVG. AREA (FT <sup>2</sup> )	DEPTH	VOLUME (FT <sup>3</sup> )	Σ VOLUME (FT <sup>3</sup> )	Σ VOLUME (AC-FT)
-1	0	1,980,000	7.8'	15,444,000	0	0
6.8	3,960,000	4,910,000	3.2'	15,712,000	15,444,000	354.5
10	5,860,000				31,156,000	715.2

STAGED STORAGE CURVE





# Lippincott Engineering Associates

501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

JOB 2089 WILLIAMS POND DAM

SHEET NO \_\_\_\_\_ OF \_\_\_\_\_

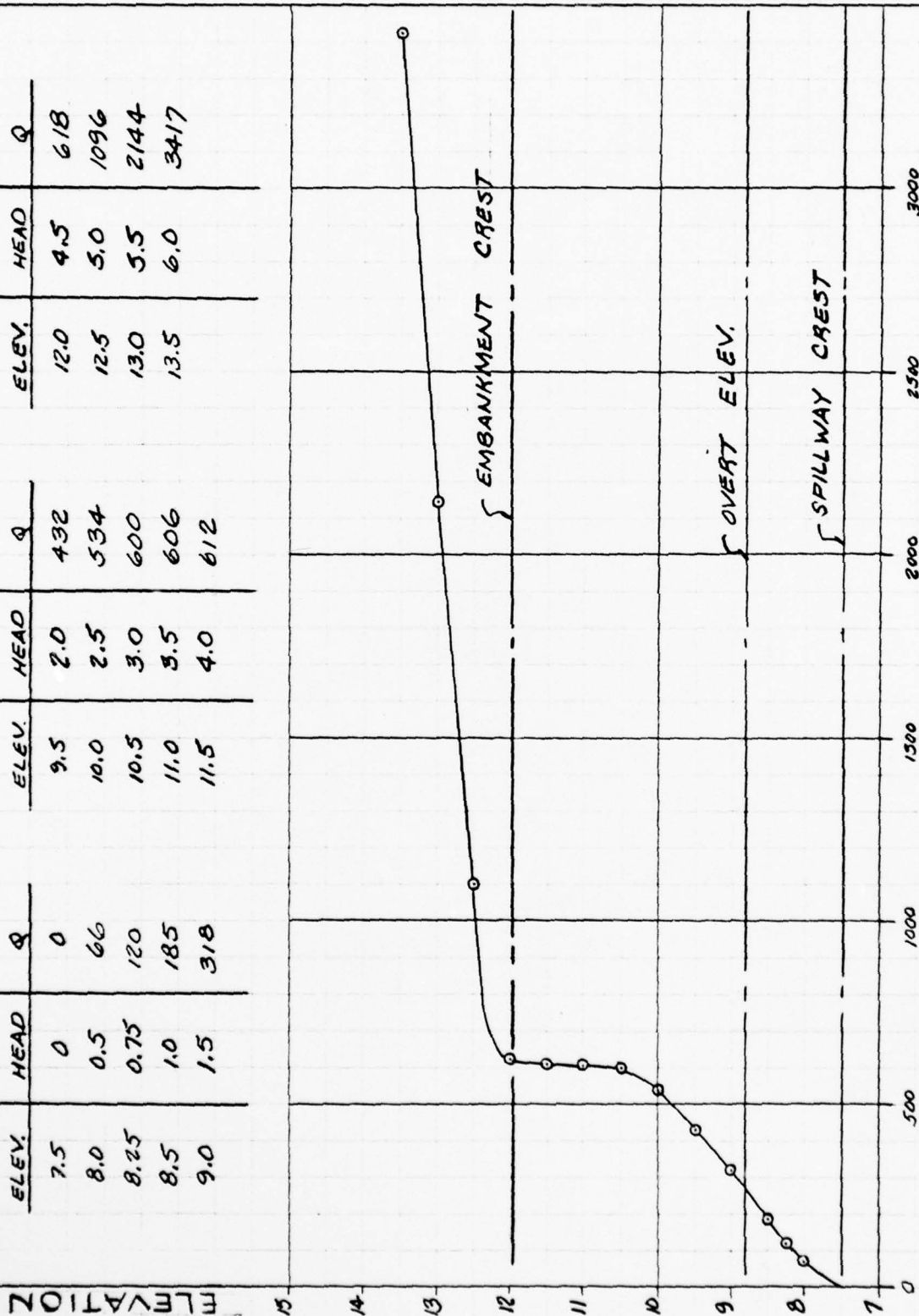
CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

## STAGED DISCHARGE - WILLIAMS POND DAM - BOARDS IN

ELEV.	HEAD	Q	ELEV.	HEAD	Q	ELEV.	HEAD	Q
7.5	0	0	9.5	2.0	432	12.0	4.5	618
8.0	0.5	66	10.0	2.5	534	12.5	5.0	1096
8.25	0.75	120	10.5	3.0	600	13.0	5.5	2144
8.5	1.0	185	11.0	3.5	606	13.5	6.0	3417
9.0	1.5	318	11.5	4.0	612			

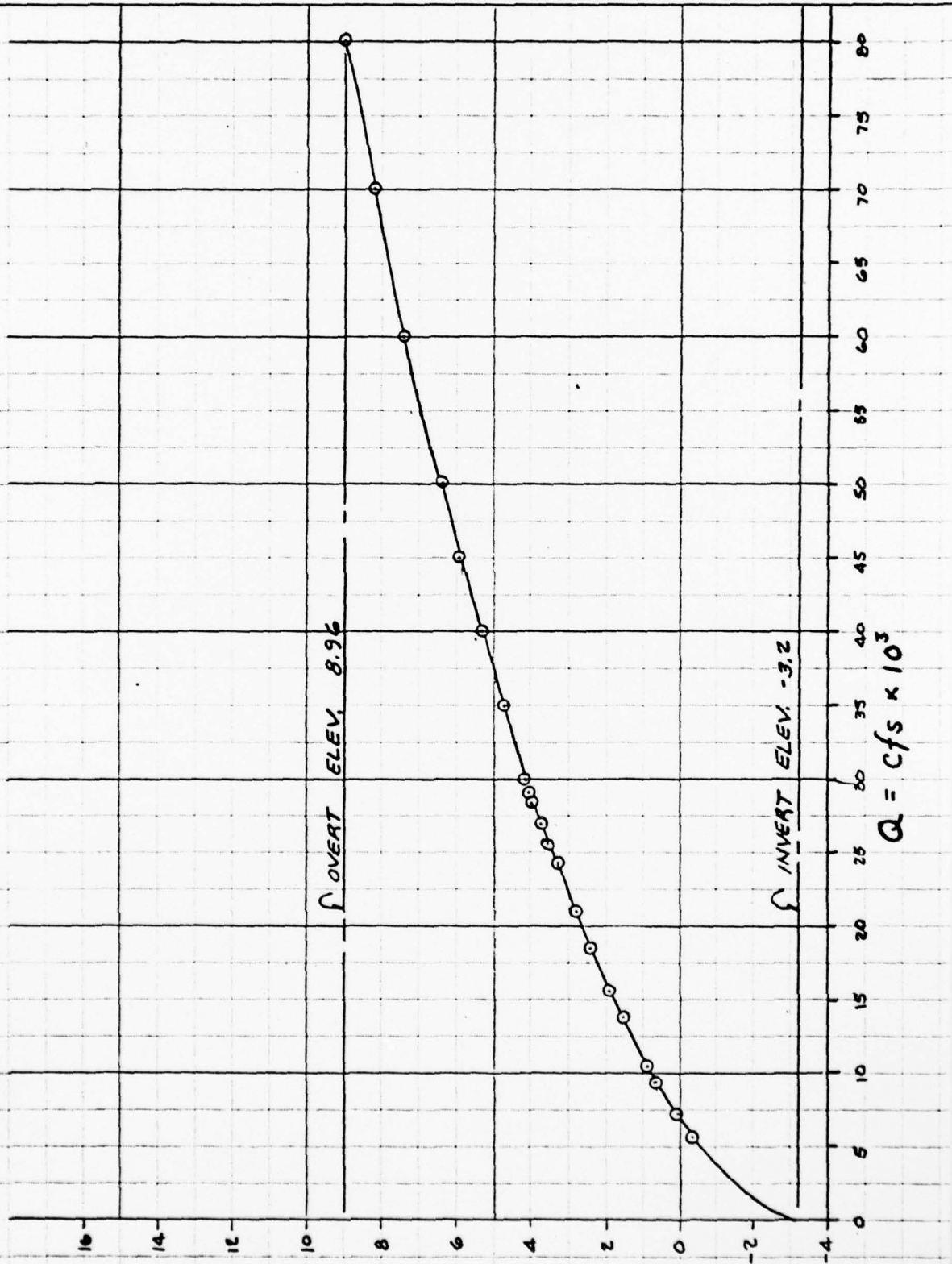




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 501 Burlington Avenue  
 DELANCO, NEW JERSEY 08075  
 Area Code (609) 461-1239

JOB 2089 WILLIAMS POND DAM  
 SHEET NO \_\_\_\_\_ OF \_\_\_\_\_  
 CALCULATED BY \_\_\_\_\_ DATE 2/79  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_

STAGED DISCHARGE THROUGH RT. 535 CULVERT





Lippincott Engineering Associates

501 Burlington Avenue  
DELANCO, NEW JERSEY 08075  
Area Code (609) 461-1239

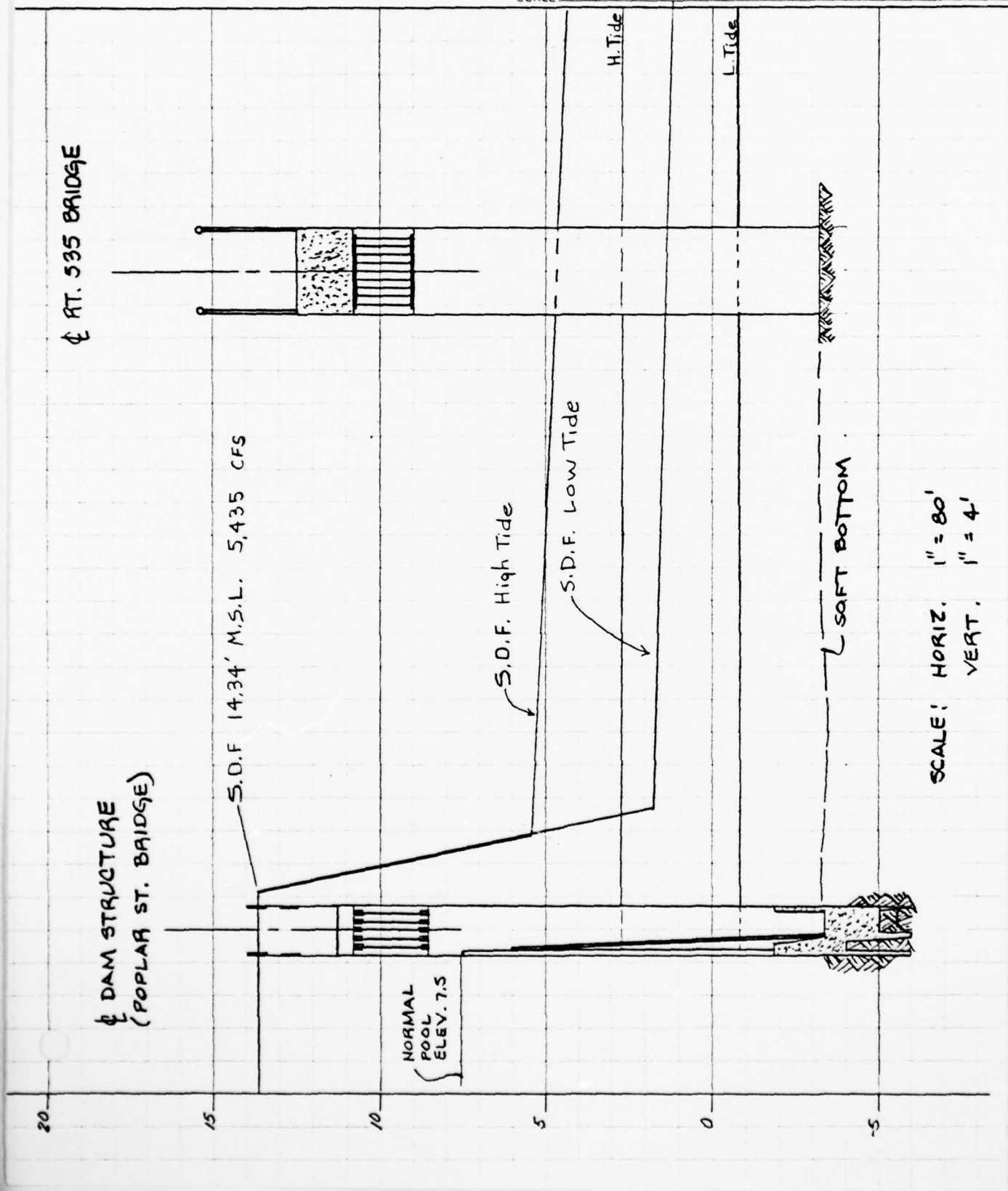
JOB 2089 WILLIAMS POND DAM

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 2/79

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_



SCALE: HORIZ. 1" = 80'  
VERT. 1" = 4'











PREVIEW OF SEQUENCE OF STEPS IN HYDRO CALCULATIONS

ROUTE HYDROGRAPH AT  
ROUTE HYDROGRAPH TO  
ROUTE HYDROGRAPH TO  
ROUTE HYDROGRAPH AT  
COMBINE 2 HYDROGRAPHS AT  
ROUTE HYDROGRAPH TO  
END OF NETWORK

1  
2  
3  
4  
5  
6



APPROXIMATE C-ARR COEFFICIENTS FROM GIVEN SLYDER CP AND TP ARE IC=13.69 AND R=17.54 INTERVALS



UNIT HYDROGRAPH WITH END-OF-PERIOD ORIGINATES, LAG= 6.52 HOURS, CP= .50 VOL= .99

600.  
488.  
276.  
156.  
88.  
50.  
26.  
16.  
9.  
5.

474.  
395.  
327.  
165.  
99.  
56.  
33.  
18.  
10.  
6.

314.  
649.  
347.  
196.  
111.  
63.  
35.  
20.  
11.  
6.

107.  
679.  
220.  
124.  
70.  
40.  
22.  
13.  
7.  
1.

50.  
671.  
435.  
246.  
139.  
74.  
44.  
27.  
15.  
9.

13.  
644.  
401.  
260.  
147.  
83.  
47.  
27.  
15.  
9.

MO,DA	HR,MIN	PERIOD	MAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO,DA	HR,MIN	PERIOD	MAIN	EXCS	LOSS	COMP Q
1.01	1.30	1	.04	0.00	.04	0.	1.02	6.30	61	0.00	0.00	0.00	1233.
1.01	1.00	2	.04	0.00	.04	0.	1.02	7.00	62	0.00	0.00	0.00	1164.
1.01	1.30	3	.04	0.00	.04	0.	1.02	7.30	63	0.00	0.00	0.00	1100.
1.01	2.00	4	.04	0.00	.04	0.	1.02	8.00	64	0.00	0.00	0.00	1039.
1.01	2.30	5	.05	0.00	.05	0.	1.02	8.30	65	0.00	0.00	0.00	981.
1.01	3.00	6	.05	0.00	.05	0.	1.02	9.00	66	0.00	0.00	0.00	927.
1.01	3.30	7	.05	0.00	.05	0.	1.02	9.30	67	0.00	0.00	0.00	875.
1.01	4.00	8	.05	0.00	.05	0.	1.02	10.00	68	0.00	0.00	0.00	827.
1.01	4.30	9	.05	0.00	.05	0.	1.02	10.30	69	0.00	0.00	0.00	781.
1.01	5.00	10	.05	0.00	.05	0.	1.02	11.00	70	0.00	0.00	0.00	738.
1.01	5.30	11	.05	0.00	.05	0.	1.02	11.30	71	0.00	0.00	0.00	697.
1.01	6.00	12	.05	0.00	.05	0.	1.02	12.00	72	0.00	0.00	0.00	658.
1.01	6.30	13	.05	0.00	.05	0.	1.02	12.30	73	0.00	0.00	0.00	622.
1.01	7.00	14	.05	0.00	.05	0.	1.02	13.00	74	0.00	0.00	0.00	587.
1.01	7.30	15	.05	0.00	.05	0.	1.02	13.30	75	0.00	0.00	0.00	555.
1.01	8.00	16	.05	0.00	.05	0.	1.02	14.00	76	0.00	0.00	0.00	524.
1.01	8.30	17	.11	.04	.06	1.	1.02	14.30	77	0.00	0.00	0.00	495.
1.01	9.00	18	.11	.08	.03	3.	1.02	15.00	78	0.00	0.00	0.00	467.
1.01	9.30	19	.13	.10	.03	10.	1.02	15.30	79	0.00	0.00	0.00	442.
1.01	10.00	20	.14	.12	.03	22.	1.02	16.00	80	0.00	0.00	0.00	417.
1.01	10.30	21	.15	.16	.03	42.	1.02	16.30	81	0.00	0.00	0.00	394.
1.01	11.00	22	.24	.22	.03	73.	1.02	17.00	82	0.00	0.00	0.00	372.
1.01	11.30	23	.33	.35	.03	118.	1.02	17.30	83	0.00	0.00	0.00	351.
1.01	12.00	24	3.00	2.48	.03	219.	1.02	18.00	84	0.00	0.00	0.00	332.
1.01	12.30	25	.57	.54	.02	407.	1.02	18.30	85	0.00	0.00	0.00	314.
1.01	13.00	26	.29	.27	.03	685.	1.02	19.00	86	0.00	0.00	0.00	296.
1.01	13.30	27	.21	.19	.03	972.	1.02	20.00	87	0.00	0.00	0.00	280.
1.01	14.00	28	.17	.14	.03	1316.	1.02	20.30	88	0.00	0.00	0.00	264.
1.01	14.30	29	.12	.09	.03	1687.	1.02	21.00	89	0.00	0.00	0.00	250.
1.01	15.00	30	.12	.09	.03	2072.	1.02	21.30	90	0.00	0.00	0.00	236.
1.01	15.30	31	.12	.09	.03	2451.	1.02	22.00	91	0.00	0.00	0.00	223.
1.01	16.00	32	.12	.09	.03	2793.	1.02	22.30	92	0.00	0.00	0.00	210.
1.01	16.30	33	.07	.05	.03	3084.	1.02	23.00	93	0.00	0.00	0.00	199.
1.01	17.00	34	.07	.05	.03	3317.	1.02	23.30	94	0.00	0.00	0.00	188.
1.01	17.30	35	.07	.05	.03	3487.	1.02	24.00	95	0.00	0.00	0.00	177.
1.01	18.00	36	.07	.05	.03	3589.	1.03	0.00	96	0.00	0.00	0.00	167.
1.01	18.30	37	.07	.05	.03	3599.	1.03	.30	97	0.00	0.00	0.00	158.
1.01	19.00	38	.07	.05	.03	3527.	1.03	1.00	98	0.00	0.00	0.00	149.
1.01	19.30	39	.07	.05	.03	3416.	1.03	1.30	99	0.00	0.00	0.00	141.
1.01	20.00	40	.07	.05	.03	3297.	1.03	2.00	100	0.00	0.00	0.00	133.
1.01	20.30	41	.05	.02	.03	3176.	1.03	2.30	101	0.00	0.00	0.00	126.
1.01	21.00	42	.05	.02	.03	3054.	1.03	3.00	102	0.00	0.00	0.00	119.
1.01	21.30	43	.05	.02	.03	2933.	1.03	3.30	103	0.00	0.00	0.00	112.
1.01	22.00	44	.05	.02	.03	2815.	1.03	4.00	104	0.00	0.00	0.00	106.



AD-A070 228

NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. WILLIAMS POND DAM (DE00064), NANTI--ETC(U)  
APR 79 I W LIPPINCOTT DACW61-78-C-0124

UNCLASSIFIED

NL

2 OF 2

AD  
A070228



END

DATE  
FILMED

7-79

DDC







ROUTE FLOWS THROUGH REAKNS POND

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.

STAGE 22.5  
FLOW 0.  
CAPACITY= 0.  
ELEVATION= 17.



1.01	15.30	31	15.50	2451.	1851.	317.	27.2
1.01	16.00	32	16.00	2791.	2113.	344.	27.4
1.01	16.30	33	16.50	3004.	3240.	357.	27.5
1.01	17.00	34	17.00	3317.	3543.	357.	27.5
ITERATIVE SOLUTION DID NOT CONVERGE 35							
1.01	17.30	35	17.50	3407.	3687.	364.	27.6
1.01	18.00	36	18.00	3588.	3537.	360.	27.5
1.01	18.30	37	18.50	3599.	3593.	360.	27.5
1.01	19.00	38	19.00	3527.	3576.	359.	27.5
1.01	19.30	39	19.50	3416.	3576.	359.	27.5
1.01	20.00	40	20.00	3297.	3549.	357.	27.5
ITERATIVE SOLUTION DID NOT CONVERGE 41							
1.01	20.30	41	20.50	3176.	2150.	348.	27.4
1.01	21.00	42	21.00	3054.	3575.	359.	27.5
ITERATIVE SOLUTION DID NOT CONVERGE 43							
1.01	21.30	43	21.50	2933.	3630.	361.	27.5
1.01	22.00	44	22.00	2815.	2225.	355.	27.5
ITERATIVE SOLUTION DID NOT CONVERGE 45							
1.01	22.30	45	22.50	2699.	3581.	359.	27.2
1.01	23.00	46	23.00	2585.	2168.	349.	27.4
ITERATIVE SOLUTION DID NOT CONVERGE 47							
1.01	23.30	47	23.50	2476.	2175.	350.	27.4
1.02	0.00	48	25.00	2370.	2240.	357.	27.5
ITERATIVE SOLUTION DID NOT CONVERGE 49							
1.02	.30	49	24.50	2267.	3589.	359.	27.5
1.02	1.00	50	25.00	2167.	2025.	335.	27.3
1.02	1.30	51	25.50	2070.	2057.	338.	27.3
1.02	2.00	52	26.00	1975.	2040.	337.	27.3
1.02	2.30	53	26.50	1882.	2006.	333.	27.3
1.02	3.00	54	27.00	1791.	1948.	327.	27.2
1.02	3.30	55	27.50	1704.	1880.	320.	27.2
1.02	4.00	56	28.00	1616.	1809.	313.	27.1
1.02	4.30	57	28.50	1536.	1728.	305.	27.1
1.02	5.00	58	29.00	1456.	1631.	297.	27.0
1.02	5.30	59	29.50	1378.	1440.	292.	26.8
1.02	6.00	60	30.00	1304.	1352.	290.	26.7
1.02	6.30	61	30.50	1233.	1277.	288.	26.7
1.02	7.00	62	31.00	1164.	1207.	286.	26.6
1.02	7.30	63	31.50	1100.	1140.	285.	26.6
1.02	8.00	64	32.00	1039.	1077.	283.	26.5
1.02	8.30	65	32.50	981.	1029.	281.	26.4
1.02	9.00	66	33.00	927.	1030.	277.	26.3
1.02	9.30	67	33.50	875.	995.	272.	26.1
1.02	10.00	68	34.00	827.	950.	267.	26.0
1.02	10.30	69	34.50	781.	915.	262.	25.8
1.02	11.00	70	35.00	738.	872.	256.	25.6
1.02	11.30	71	35.50	697.	831.	251.	25.4
1.02	12.00	72	36.00	658.	791.	245.	25.2



1.02	15.30	73	30.70	627.	751.	240.	250.
1.02	13.00	74	37.00	587.	713.	234.	240.
1.02	13.30	75	37.50	555.	676.	229.	240.
1.02	14.00	76	38.00	524.	640.	224.	240.
1.02	14.30	77	38.50	495.	608.	220.	240.
1.02	15.00	78	39.00	467.	577.	215.	240.
1.02	15.30	79	39.50	442.	549.	211.	240.
1.02	16.00	80	40.00	417.	519.	206.	240.
1.02	16.30	81	40.50	394.	492.	202.	240.
1.02	17.00	82	41.00	372.	465.	198.	240.
1.02	17.30	83	41.50	351.	440.	195.	240.
1.02	18.00	84	42.00	332.	409.	191.	240.
1.02	18.30	85	42.50	314.	384.	189.	240.
1.02	19.00	86	43.00	296.	337.	187.	240.
1.02	19.30	87	43.50	280.	314.	185.	240.
1.02	20.00	88	44.00	264.	295.	184.	240.
1.02	20.30	89	44.50	250.	277.	183.	240.
1.02	21.00	90	45.00	236.	261.	182.	240.
1.02	21.30	91	45.50	223.	247.	181.	240.
1.02	22.00	92	46.00	210.	233.	180.	240.
1.02	22.30	93	46.50	199.	220.	179.	240.
1.02	23.00	94	47.00	186.	207.	178.	240.
1.02	23.30	95	47.50	177.	196.	177.	240.
1.03	0.00	96	48.00	167.	185.	177.	240.
1.03	.30	97	48.50	158.	175.	176.	240.
1.03	1.00	98	49.00	149.	165.	175.	240.
1.03	1.30	99	49.50	141.	156.	175.	240.
1.03	2.00	100	50.00	133.	147.	174.	240.
1.03	2.30	101	50.50	126.	139.	173.	240.
1.03	3.00	102	51.00	119.	131.	173.	240.
1.03	3.30	103	51.50	112.	124.	172.	240.
1.03	4.00	104	52.00	106.	117.	172.	240.
1.03	4.30	105	52.50	100.	111.	171.	240.
1.03	5.00	106	53.00	95.	105.	171.	240.
1.03	5.30	107	53.50	89.	99.	171.	240.
1.03	6.00	108	54.00	84.	93.	170.	240.
1.03	6.30	109	54.50	80.	88.	170.	240.
1.03	7.00	110	55.00	75.	83.	170.	240.
1.03	7.30	111	55.50	71.	79.	169.	240.
1.03	8.00	112	56.00	67.	74.	169.	240.
1.03	8.30	113	56.50	63.	70.	169.	240.
1.03	9.00	114	57.00	60.	66.	168.	240.
1.03	9.30	115	57.50	57.	63.	168.	240.
1.03	10.00	116	58.00	54.	59.	168.	240.
1.03	10.30	117	58.50	50.	56.	168.	240.
1.03	11.00	118	59.00	47.	53.	167.	240.
1.03	11.30	119	59.50	44.	49.	167.	240.
1.03	12.00	120	60.00	41.	46.	167.	240.

PEAK OUTFLOW IS 36d/ AT TIME 17.50 HOURS

CF5	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CMS	3687.	3350.	1980.	888.	106528.
INCHES	104.	95.	56.	25.	3017.
MM		2.33	5.50	6.16	6.16
AC-FI		59.1d	134.6d	156.53	156.53
THOUS CU 4		1004.	3928.	4402.	4402.
		2053.	4845.	5430.	5430.











1.02	12.30	73	104.	771.	847.	13.3	0.
1.02	13.00	74	100.	732.	808.	13.2	0.
1.02	13.30	75	90.	694.	769.	13.1	0.
1.02	14.00	76	92.	658.	731.	13.0	0.
1.02	14.30	77	88.	624.	695.	12.9	0.
1.02	15.00	78	85.	593.	662.	12.8	0.
1.02	15.30	79	81.	563.	630.	12.7	0.
1.02	16.00	80	78.	533.	599.	12.6	0.
1.02	16.30	81	75.	505.	569.	12.5	0.
1.02	17.00	82	72.	479.	540.	12.4	0.
1.02	17.30	83	69.	453.	512.	12.3	0.
1.02	18.00	84	66.	428.	483.	12.2	0.
1.02	18.30	85	62.	398.	453.	12.0	0.
1.02	19.00	86	58.	368.	422.	11.9	0.
1.02	19.30	87	55.	338.	392.	11.8	0.
1.02	20.00	88	52.	308.	362.	11.7	0.
1.02	20.30	89	49.	280.	342.	11.6	0.
1.02	21.00	90	47.	254.	321.	11.5	0.
1.02	21.30	91	44.	228.	302.	11.4	0.
1.02	22.00	92	42.	202.	284.	11.3	0.
1.02	22.30	93	40.	176.	268.	11.2	0.
1.02	23.00	94	38.	150.	252.	11.1	0.
1.02	23.30	95	36.	124.	238.	11.0	0.
1.03	0.00	96	35.	100.	224.	10.9	0.
1.03	0.30	97	33.	76.	212.	10.8	0.
1.03	1.00	98	31.	52.	201.	10.7	0.
1.03	1.30	99	30.	29.	180.	10.6	0.
1.03	2.00	100	27.	152.	160.	10.5	0.
1.03	2.30	101	26.	128.	143.	10.4	0.
1.03	3.00	102	25.	104.	121.	10.3	0.
1.03	3.30	103	24.	80.	101.	10.2	0.
1.03	4.00	104	23.	56.	81.	10.1	0.
1.03	4.30	105	22.	32.	60.	10.0	0.
1.03	5.00	106	21.	8.	40.	9.9	0.
1.03	5.30	107	20.	1.	20.	9.8	0.
1.03	6.00	108	19.	1.	1.	9.7	0.
1.03	6.30	109	18.	1.	1.	9.6	0.
1.03	7.00	110	17.	1.	1.	9.5	0.
1.03	7.30	111	16.	1.	1.	9.4	0.
1.03	8.00	112	15.	1.	1.	9.3	0.
1.03	8.30	113	14.	1.	1.	9.2	0.
1.03	9.00	114	13.	1.	1.	9.1	0.
1.03	9.30	115	12.	1.	1.	9.0	0.
1.03	10.00	116	11.	1.	1.	8.9	0.
1.03	10.30	117	10.	1.	1.	8.8	0.
1.03	11.00	118	9.	1.	1.	8.7	0.
1.03	11.30	119	8.	1.	1.	8.6	0.
1.03	12.00	120	7.	1.	1.	8.5	0.

SUM 106274.  
3009.351

CFD	PEAF	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CHS	3555.	3262.	1986.	845.	106245.
INCHES	101.	92.	56.	25.	3009.
M4		2.26	5.46	6.15	6.15
AL-FI		57.53	138.60	156.12	156.12
THOUS CU Y		1618.	3899.	4390.	4390.
		1975.	4810.	5415.	5415.



$$\text{Maximum Storage} = 30''.$$

MAXIMUM STAGE IS 11.3

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## SUB-AQUA KUNUFF COMPUTATION

INFLUENCE PROGRAM TO WILLIAMS POND

ESTAC	ICOMP	RECON	ITAPE	JPLT	JPHI	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

	IMUG	LUMS	TAKA	SNAP	TRSDA	TRSPC	MATIO	ISNUM	ISAME	LOCAL
	0	1	9.83	0.00	9.83	0.00	0.000	0	1	0

PRECIP DATA		
NP	STORM	UAG
48	7.96	0.00

[illegible]

### LOSS DATA

	EXCPT	STKRM	ULTAK	RTIOL	CHAIN	STKRS	RITOK	STPIL	CNSTL	ALSMX	HTIMP
	0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

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UNIT HYDROGRAPH DATA
IP= 6.60 CP= .50 N/A= 0
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## RECESSION DATA

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP AVE TC=16.36 AND R=16.50 INTERVALS

UNIT HYDROGRAPH+100 END-OF-PERIOD ORDINATES, LAG= 6.79 HOURS, CP= .50 VOL= .99

33.	67.	108.	154.	204.	257.	310.	360.	401.
354.	474.	474.	468.	445.	422.	400.	379.	359.
322.	305.	289.	274.	259.	246.	233.	221.	209.
188.	178.	164.	154.	151.	143.	136.	128.	122.
109.	103.	93.	84.	84.	83.	79.	75.	71.
64.	60.	57.	54.	51.	49.	46.	44.	41.
37.	35.	33.	32.	30.	28.	27.	25.	24.
22.	20.	19.	18.	17.	16.	16.	15.	14.
13.	11.	11.	10.	10.	10.	9.	9.	8.
7.	7.	7.	6.	6.	6.	5.	5.	5.

4013 001R34-40-0N4

Q	MO.DA	HR.MM	PERIOD	MAIN	EXCS	LOSS	COMP Q	END-OF-PERIOD FLOW	HR.MM	PERIOD	MAIN	EXCS	LOSS	COMP Q
	1.01	.30	1	.04	0.00	.04	0.	1.02	6.30	61	0.00	0.00	0.00	946.
	1.01	1.00	2	.04	0.00	.04	0.	1.02	7.00	62	0.00	0.00	0.00	897.
	1.01	1.30	3	.04	0.00	.04	0.	1.30	7.30	63	0.00	0.00	0.00	850.















1.01	7.30	15	7.50	0.	66.	393.	7.1
1.01	8.00	16	8.00	0.	66.	390.	7.1
1.01	8.30	17	8.50	0.	66.	387.	7.1
1.01	9.00	18	9.00	0.	66.	385.	7.1
1.01	9.30	19	9.50	7.	66.	382.	7.0
1.01	10.00	20	10.00	15.	66.	380.	7.0
1.01	10.30	21	10.50	23.	66.	378.	7.0
1.01	11.00	22	11.00	53.	66.	377.	7.0
1.01	11.30	23	11.50	89.	66.	377.	7.0
1.01	12.00	24	12.00	169.	66.	380.	7.0
1.01	12.30	25	12.50	321.	66.	387.	7.1
1.01	13.00	26	13.00	545.	66.	402.	7.2
1.01	13.30	27	13.50	830.	66.	428.	7.4
1.01	14.00	28	14.00	1165.	66.	467.	7.8
1.01	14.30	29	14.50	1548.	129.	519.	8.3
1.01	15.00	30	15.00	2014.	271.	584.	8.8
1.01	15.30	31	15.50	2589.	437.	664.	9.6
1.01	16.00	32	16.00	3206.	580.	763.	10.2
1.01	16.30	33	16.50	4050.	664.	887.	10.8
1.01	17.00	34	17.00	4931.	782.	1042.	11.5
1.01	17.30	35	17.50	5495.	1226.	1216.	12.3
1.01	18.00	36	18.00	5836.	2845.	1366.	13.0
1.01	18.30	37	18.50	5996.	3817.	1473.	13.5
1.01	19.00	38	19.00	6038.	4513.	1550.	13.9
1.01	19.30	39	19.50	6002.	4990.	1602.	14.1
1.01	20.00	40	20.00	5933.	5299.	1636.	14.3
1.01	20.30	41	20.50	5525.	5435.	1651.	14.3
1.01	21.00	42	21.00	5277.	5424.	1650.	14.3
1.01	21.30	43	21.50	5444.	5405.	1648.	14.3
1.01	22.00	44	22.00	5186.	5377.	1645.	14.3
1.01	22.30	45	22.50	5003.	5288.	1635.	14.3
1.01	23.00	46	23.00	4855.	5175.	1622.	14.2
1.01	23.30	47	23.50	4419.	5005.	1604.	14.1
1.02	0.00	48	24.00	4170.	4780.	1579.	14.0
1.02	.30	49	24.50	4322.	4611.	1560.	13.9
1.02	1.00	50	25.00	4327.	4520.	1550.	13.9
1.02	1.30	51	25.50	3951.	4400.	1537.	13.8
1.02	2.00	52	26.00	3723.	4222.	1518.	13.7
1.02	2.30	53	26.50	3557.	4037.	1497.	13.6
1.02	3.00	54	27.00	3416.	3863.	1478.	13.5
1.02	3.30	55	27.50	3285.	3701.	1460.	13.5
1.02	4.00	56	28.00	3154.	3548.	1444.	13.4
1.02	4.30	57	28.50	3022.	3403.	1428.	13.3
1.02	5.00	58	29.00	2886.	3261.	1412.	13.2
1.02	5.30	59	29.50	2723.	3116.	1396.	13.2
1.02	6.00	60	30.00	2552.	2965.	1379.	13.1
1.02	6.30	61	30.50	2403.	2811.	1362.	13.0
1.02	7.00	62	31.00	2265.	2670.	1339.	12.9
1.02	7.30	63	31.50	2138.	2555.	1316.	12.8
1.02	8.00	64	32.00	2022.	2299.	1302.	12.7
1.02	8.30	65	32.50	1926.	2123.	1292.	12.7
1.02	9.00	66	33.00	1844.	1995.	1285.	12.6
1.02	9.30	67	33.50	1767.	1894.	1279.	12.6
1.02	10.00	68	34.00	1693.	1807.	1275.	12.6
1.02	10.30	69	34.50	1619.	1727.	1270.	12.6
1.02	11.00	70	35.00	1547.	1651.	1266.	12.6
1.02	11.30	71	35.50	1477.	1577.	1262.	12.5
1.02	12.00	72	36.00	1409.	1506.	1258.	12.5
1.02	12.30	73	36.50	1342.	1432.	1254.	12.5
1.02	13.00	74	37.00	1277.	1407.	1249.	12.5



1.02	13.30	75	37.50	1214.	1374.	1243.	12.5
1.02	14.00	76	38.00	1152.	1330.	1236.	12.4
1.02	14.30	77	38.50	1094.	1291.	1228.	12.4
1.02	15.00	78	39.00	1040.	1247.	1220.	12.3
1.02	15.30	79	39.50	988.	1200.	1211.	12.3
1.02	16.00	80	40.00	938.	1152.	1203.	12.3
1.02	16.30	81	40.50	890.	1104.	1194.	12.2
1.02	17.00	82	41.00	844.	1056.	1185.	12.2
1.02	17.30	83	41.50	800.	1008.	1177.	12.1
1.02	18.00	84	42.00	757.	962.	1168.	12.1
1.02	18.30	85	42.50	711.	916.	1160.	12.1
1.02	19.00	86	43.00	667.	870.	1151.	12.0
1.02	19.30	87	43.50	624.	836.	1143.	12.0
1.02	20.00	88	44.00	585.	803.	1133.	11.9
1.02	20.30	89	44.50	550.	771.	1122.	11.9
1.02	21.00	90	45.00	519.	740.	1110.	11.8
1.02	21.30	91	45.50	489.	711.	1098.	11.8
1.02	22.00	92	46.00	461.	685.	1084.	11.7
1.02	22.30	93	46.50	435.	662.	1069.	11.6
1.02	23.00	94	47.00	411.	641.	1054.	11.6
1.02	23.30	95	47.50	388.	622.	1038.	11.5
1.03	0.00	96	48.00	367.	602.	1022.	11.4
1.03	0.30	97	48.50	346.	584.	1005.	11.3
1.03	1.00	98	49.00	329.	567.	988.	11.3
1.03	1.30	99	49.50	312.	552.	970.	11.2
1.03	2.00	100	50.00	295.	537.	952.	11.1
1.03	2.30	101	50.50	279.	522.	934.	11.0
1.03	3.00	102	51.00	264.	508.	915.	10.9
1.03	3.30	103	51.50	250.	492.	897.	10.8
1.03	4.00	104	52.00	236.	477.	879.	10.8
1.03	4.30	105	52.50	223.	462.	861.	10.7
1.03	5.00	106	53.00	212.	447.	843.	10.6
1.03	5.30	107	53.50	200.	432.	825.	10.5
1.03	6.00	108	54.00	190.	417.	807.	10.4
1.03	6.30	109	54.50	180.	402.	790.	10.3
1.03	7.00	110	55.00	170.	388.	772.	10.3
1.03	7.30	111	55.50	161.	375.	755.	10.2
1.03	8.00	112	56.00	152.	359.	738.	10.1
1.03	8.30	113	56.50	144.	345.	721.	10.0
1.03	9.00	114	57.00	136.	329.	705.	9.9
1.03	9.30	115	57.50	129.	314.	690.	9.8
1.03	10.00	116	58.00	122.	300.	675.	9.8
1.03	10.30	117	58.50	115.	287.	662.	9.5
1.03	11.00	118	59.00	109.	274.	649.	9.4
1.03	11.30	119	59.50	103.	262.	637.	9.3
1.03	12.00	120	60.00	97.	250.	626.	9.2

PEAK OUTFLOW IS 5435. AT TIME 20.50 HOURS

CF5	PEAK	0-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CMS	5435.	5109.	3076.	1486.	178349.
INCHES	154.	145.	87.	42.	5050.
M4		2.05	4.93	5.95	5.95
AC-FT		51.90	125.14	151.17	151.17
THOUS CU *		2533.	6101.	7370.	7370.
		3125.	7525.	9091.	9091.



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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN RATIO	1 1.00
HYDROGRAPH AT ROUTED TO ROUTED TO	1	13.40 ( 34.71)	1	3599. ( 101.91)
	2	13.40 ( 34.71)	1	3687. ( 104.39)
	3	13.40 ( 34.71)	1	3555. ( 100.07)
HYDROGRAPH AT 2 COMBINED ROUTED TO	4	9.83 ( 25.46)	1	2526. ( 71.53)
	5	23.23 ( 60.17)	1	6038. ( 170.77)
	6	23.23 ( 60.17)	1	5435. ( 153.91)



SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

RATIO OF P/F	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
		22.50	25.00	27.00		
		164.	238.	298.		
		0.	742.	1001.		
MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS	
1.00	364.	367.	13.50	17.50	0.00	

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW-CFS	MAXIMUM STAGE-FT	TIME HOURS
1.00	3555.	17.3	20.00



SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 7.50 434. 00.	SPILLWAY GUEST 7.50 434. 00.	TOP OF DAM 12.00 1146. 840.	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	MAXIMUM STORAGE AC-FT	MAXIMUM DEPTH OVER DAM	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
						5435.	1051.	2.34	1.00	14.34	20.50	0.00